

GAO

Report to the Subcommittee on
Seapower, Committee on Armed
Services, U.S. Senate

November 2001

FORCE STRUCTURE

Options for Enhancing the Navy's Attack Submarine Force



Report Documentation Page		
Report Date 00NOV2001	Report Type N/A	Dates Covered (from... to) -
Title and Subtitle FORCE STRUCTURE: Options for Enhancing the Navys Attack Submarine Force	Contract Number	
	Grant Number	
	Program Element Number	
Author(s)	Project Number	
	Task Number	
	Work Unit Number	
Performing Organization Name(s) and Address(es) General Accountning Office, PO Box 37050, Washington, DC 20013	Performing Organization Report Number GAO-02-97	
Sponsoring/Monitoring Agency Name(s) and Address(es)	Sponsor/Monitor's Acronym(s)	
	Sponsor/Monitor's Report Number(s)	
Distribution/Availability Statement Approved for public release, distribution unlimited		
Supplementary Notes		
Abstract Maintaining a capable, appropriately sized submarine force is an integral part of the United States strategy for deterring, and, if necessary, conducting wartime operations. Since the end of the Cold War, significant changes in the strategic environment have led the Department of Defense (DOD) to reduce the size of its submarine force. The United States has two types of submarines, both of which are nuclear-powered: attack submarines (SSN) and ballistic missile submarines (SSBN). Attack submarines are part of the conventional forces and have capabilities in several mission areas including intelligence, surveillance, and reconnaissance, undersea warfare, strike warfare, and special operations warfare. Ballistic missile submarines are part of the strategic forces and are capable of launching strategic nuclear weapons upon short notice. The Trident ballistic missile submarine force consists of 18 Ohio-class (SSBN-726) submarines. 1 DOD has determined that it only needs 14 Trident SSBNs to meet future requirements for strategic weapons and developed plans in the 1990s to retire 4 of its 18 Trident SSBNs during fiscal years 2003-2004. 2		
Subject Terms		
Report Classification unclassified	Classification of this page unclassified	

Classification of Abstract unclassified	Limitation of Abstract SAR
Number of Pages 92	

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Abbreviations

DOD	Department of Defense
SEAL	Sea-Air-Land (naval special forces team member)
SOF	Special Operations Forces
SSBN	Nuclear-Powered Ballistic Missile Submarine
SSGN	Nuclear-Powered Guided Missile Submarine
SSN	Nuclear-Powered Attack Submarine
START	Strategic Arms Reduction Treaties



United States General Accounting Office
Washington, DC 20548

November 14, 2001

The Honorable Edward M. Kennedy
Chairman
The Honorable Jeff Sessions
Ranking Minority Member
Subcommittee on Seapower,
Committee on Armed Services
United States Senate

Maintaining a capable, appropriately sized submarine force is an integral part of the United States' strategy for deterring, and, if necessary, conducting wartime operations. Since the end of the Cold War, significant changes in the strategic environment have led the Department of Defense (DOD) to reduce the size of its submarine force. The United States has two types of submarines, both of which are nuclear-powered: attack submarines (SSN) and ballistic missile submarines (SSBN). Attack submarines are part of the conventional forces and have capabilities in several mission areas including intelligence, surveillance, and reconnaissance, undersea warfare, strike warfare, and special operations warfare. Ballistic missile submarines are part of the strategic forces and are capable of launching strategic nuclear weapons upon short notice. The Trident ballistic missile submarine force consists of 18 Ohio-class (SSBN-726) submarines.¹ DOD has determined that it only needs 14 Trident SSBNs to meet future requirements for strategic weapons and developed plans in the 1990s to retire 4 of its 18 Trident SSBNs during fiscal years 2003-2004.²

In the 1990s, DOD also decided to retire several attack submarines by 2003 because of lower submarine force structure requirements. Most of DOD's current force of 55 nuclear-powered attack submarines are part of the Los Angeles-class (SSN-688).³ DOD's plan would have reduced attack

¹ The first ship of the class, the U.S.S. *Ohio*, was commissioned in 1981. Trident submarines take their name from the Trident ballistic missiles they carry.

² *Analysis of Converting Trident-Class Ballistic Missile Submarines (SSBNs) to Nuclear-Powered Guided-Missile Submarines (SSGNs)*, Office of the Secretary of Defense, Final Report, June 1999.

³ There are currently 51 *Los Angeles*-class submarines in the force. The first of the class, U.S.S. *Los Angeles*, was commissioned in 1976.

submarine force levels to about 50. However, in 1999, a Chairman of the Joint Chiefs of Staff study concluded that a force structure below 55 attack submarines in 2015 and 62 attack submarines in 2025 would leave regional military commanders-in-chief with insufficient capability to respond to urgent critical demands.⁴ To avoid the force falling below 55 with scheduled retirements, DOD began considering options to increase attack submarine force levels. Specifically, DOD evaluated and estimated the cost of (1) refueling SSN-688 class submarines and (2) refueling and converting four Trident submarines scheduled for inactivation in fiscal years 2003-2004. The Trident submarines were to be converted to guided missile submarines (known as SSGN) to carry conventional Tomahawk land-attack missiles and special operations forces.

This report summarizes and updates our analyses of submarine force options provided in briefings to your staff in June and July 2001. We evaluated options for enhancing the attack submarine force to maintain a minimum of 55 attack submarines through 2035. To address your request, we assessed the following options:

- refueling four SSN-688 attack submarines;
- refueling four SSN-688 attack submarines and, upon reaching the end of their operational life after 10-12 years, replacing them with four new Virginia-class attack submarines;⁵
- refueling and converting four Trident SSBNs to SSGNs; and
- refueling four SSN-688 attack submarines and converting two Trident SSBNs to SSGNs.

Our objectives were to determine how these options compare in terms of their (1) effects on DOD's ability to maintain at least 55 attack submarines through fiscal year 2035, (2) capabilities to perform peacetime and wartime missions, including their relative contributions to the Navy's strike mission, and their transformational potential,⁶ and (3) operational

⁴ *Chairman of the Joint Chiefs of Staff Attack Submarine Study*, Joint Chiefs of Staff, November 1999.

⁵ The *Virginia*-class attack submarine, formerly called the New Attack Submarine, is the Navy's newest class of attack submarines. The scheduled commissioning for the first ship in the class is in 2004.

⁶ Transformation is a process of change that involves developing new operational concepts, experimenting to determine which ones work and which do not, and implementing those that do.

life-cycle costs⁷ and cost-effectiveness. To assess the options' effects on DOD's projected submarine force structure through fiscal year 2035, we used the Navy's current force structure and long-range shipbuilding plans as a baseline. The documents reflect plans to deliver 18 new Virginia-class attack submarines by fiscal year 2016. Our analysis did not include an assessment of the basis for the Chairman of the Joint Chiefs of Staff study's conclusion that DOD will require a minimum of 55 attack submarines in the future. Rather, at your request, we focused on assessing options for helping DOD to achieve this level of capability. Because each option provides certain advantages, the weight attached to each advantage is often subjective, and we did not assess the capabilities of other DOD weapon systems, we have not drawn a conclusion about which option is best.

Results in Brief

All four options help to reverse a projected decline in attack submarine force levels below the Chairman of the Joint Chiefs of Staff Attack Submarine Study's minimum requirement of 55, but they vary considerably in terms of the number of years they allow DOD to meet this goal. Refueling four SSN-688s and replacing them with four additional Virginia-class attack submarines once their service life expires would provide a force level of at least 55 submarines for 32 of the 34 years during fiscal years 2002-2035. Refueling and converting four Trident SSBNs to SSGNs would provide a force of 55 submarines for 28 years. Refueling four SSN-688s and converting two Trident SSBNs to SSGNs would provide a force of 55 submarines for 27 years. Finally, refueling four SSN-688s without plans to replace them with additional Virginia-class submarines would allow DOD to meet its goal of 55 submarines for 24 of 34 years.

Both the refueled SSN-688s and SSGNs would be capable of performing a variety of peacetime and wartime missions, but they differ in the extent to which they can perform these missions. Refueled SSN-688s would have somewhat better capabilities than SSGNs to conduct intelligence, surveillance, and reconnaissance; support aircraft carrier battle groups; and perform undersea and surface warfare. However, SSGNs would have significantly better capabilities to strike targets ashore and conduct special operations. An SSGN would provide significantly more presence

⁷ Operational life-cycle costs include estimated acquisition, operations, maintenance and personnel costs during the options' projected operational service life.

days⁸ per year than a refueled SSN-688—242 days versus 73 days—because SSGNs would have two crews per submarine. These crews would be rotated during the middle of planned deployments and, on average, would allow the SSGNs to accrue more presence days than a refueled SSN-688. Finally, SSGNs would also provide a superior capability to support the Navy’s transformation plans because their large size and longer service life could support new technologies and weapons and because their stealth capability should help them survive and operate in a high-threat environment.

The operational life-cycle costs and cost-effectiveness of the four options also differ significantly. As table 1 shows, the net present value⁹ life-cycle cost of the four options ranges from \$1.8 billion for refueling four SSN-688s to \$6.6 billion to refuel four SSN-688s and to replace them with four Virginia-class submarines upon their retirement after 10-12 years.

Table 1: Net Present Value Operational Life-Cycle Cost for Submarine Force Options

Dollars in billions			
Option	Option description	Fiscal year 2001 dollars	Net present value
1	Refuel four SSN-688s	\$2.2	\$1.8
2	Refuel four SSN-688s and buy four Virginia-class replacements	7.6	6.6
3	Convert four Trident SSBNs to SSGNs	6.6	4.8
4	Refuel four SSN-688s and convert two Trident SSBNs to SSGNs	5.6	4.2

Source: GAO analysis.

Converting four Trident ballistic missile submarines to SSGNs is more cost-effective than the other options in providing overseas presence. This option’s cost per presence day is \$234,000—the lowest of any option. In contrast, refueling four SSN-688s and converting two Trident SSBNs to SSGNs would cost \$311,000 per day; refueling four SSN-688s would cost

⁸ By presence days, we mean the number of days during a year either type of submarine could spend deployed to overseas theaters. Presence days do not include time in the submarines’ homeport or in transit to the overseas theaters.

⁹ Present value analysis converts costs occurring at different times to a common unit of measurement by recognizing the time value of money.

about \$555,000 per presence day; and refueling four SSN-688s and replacing them with four new Virginia-class submarines would cost \$1.1 million per day. Converting four Trident submarines to SSGNs would also provide a significantly more cost-effective capability to launch Tomahawk missiles and provide special operations units than the other options.

Agency Comments and Our Evaluation

DOD's written comments on a draft of this report are included as appendix I. The Department generally agreed with the report but noted that our cost-effectiveness comparison did not account for platform replacement costs in all four options or across the same number of years. As described in our methodology section, we had to use different periods of analysis to match the differing operational lifespans of the two submarines. Each option provides benefits over different periods thereby making direct comparisons difficult. However, to make the options more comparable, we included an option that buys four Virginia-class submarines to replace refueled SSN-688 submarines once they reach the end of their useful life. By adding the depreciated acquisition costs and the operating and support costs for the first 10-12 years of the replacement submarines to the costs associated with the refueled SSN-688s, this option becomes more directly comparable to the costs associated with the 20-22 year life of the SSGN. We did not assess options that would involve replacing SSGNs after 22 years because DOD has not developed any requirements or cost estimates for their replacement.

DOD also noted that appropriate metrics would need to be developed for all mission areas to fully assess SSN-688 and SSGNs across a broad set of missions. Our report notes that the Navy lacks suitable metrics for missions such as intelligence, surveillance, and reconnaissance. Moreover, we agree that it would be helpful if it developed such metrics.

Scope and Methodology

To identify how the proposed options would affect the Navy's submarine force structure during fiscal years 2002–2035, we met with Navy officials and obtained pertinent documents concerning the Navy's currently planned submarine force structure for that period and options it has under consideration for increasing that structure. We then applied those and

other options¹⁰ to the currently planned force structure to determine the effect of each over the 34-year period. We did not assess the Chairman of the Joint Chiefs of Staff Attack Submarine Study's evaluation that the Navy needs a minimum of 55 attack submarines to meet critical demands. We evaluated submarine force options through 2035 because the attack submarine's notional life-cycle is very long: an 8-year procurement period¹¹ followed by 33 years of operational service life.

To determine how the options to refuel SSN-688 attack submarines or to convert Trident SSBNs to SSGNs compared in terms of mission capabilities, we met with joint command and Navy officials. Appendix II includes a list of the organizations we contacted. We discussed the various missions in which the submarines would be engaged and the capabilities of the refueled SSN-688s and the SSGNs in performing those missions with those officials. In addition, we analyzed information the officials provided to determine each option's contribution to performing those missions. We also compared the number of presence days each option would provide. We compared the respective capabilities of each type of submarine with surface combatants in carrying Tomahawk land attack missiles and the contributions each would make to peacetime and wartime operations. We also toured SSN-688 and Trident submarines to obtain a better understanding of their capabilities and, in the case of Tridents, how they would be modified to accommodate special forces and Tomahawk Land Attack missiles. To assess the submarines' respective transformational potential we met with defense and industry officials and reviewed several reports on their potential contributions to transformation and experimentation. We also observed the employment of SSGNs in a major wargame that evaluates new operational concepts.

To determine the options' life-cycle costs and compare their cost-effectiveness, we met with Navy officials and obtained estimated procurement, operations, maintenance, and personnel costs for the options' respective time periods. We then determined the cost for each

¹⁰ Since the refueled SSN-688s would have a service life of about 12 years after refueling, we added an option of acquiring and operating four additional *Virginia*-class (SSN-774) submarines in order to have a time period comparable to the SSGN's 20-22 year service life. We included 10-12 years of *Virginia*-class acquisition and operating and support costs in this option.

¹¹ The procurement period includes 2 years for the advance procurement of long-lead items and 6 years of construction. The procurement decision is normally preceded by a 2-year budget cycle.

option by fiscal year, converted the costs into fiscal year 2001 dollars, and calculated each option's net present value using a real discount rate. Because alternative choices are being compared, we included, as appropriate, the cost of decommissioning submarines not chosen for further service.¹² We also combined the results of our cost and other analyses to derive a cost per presence day, cost per Tomahawk presence day, and cost per Special Operations Forces platoon presence day for each option.

We conducted our review between January 2001 and August 2001 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Honorable Donald H. Rumsfeld, Secretary of Defense; the Honorable Gordon R. England, Secretary of the Navy; the Honorable Mitchell E. Daniels, Jr., Director, Office of Management and Budget; and other interested parties. We will make copies available to others on request. The report will also be available on GAO's Web site at <http://www.gao.gov>.

If you or your staff have any questions, please call me on (202) 512-5140 or by e-mail at schusterc@gao.gov. Major contributors to this report are Janet St. Laurent, Roderick W. Rodgers, Tim F. Stone, Suzanne K. Wren, Mary Jo LaCasse, Charles Perdue, and Susan Woodward.



Carol R. Schuster
Director
Defense Capabilities and Management

¹² For example, if the four SSN-688s were refueled, DOD would incur the cost of decommissioning four Trident SSBNs in addition to the cost of the SSN refueling program. Conversely, if the Trident SSBNs are refueled and converted, DOD would need to fund decommissioning the four SSN-688s.

Briefing Section I: Background



Background

- Changes in the post-Cold War environment led DOD to reduce its ballistic missile and attack submarine forces.
- In 1997, DOD's Quadrennial Defense Review established a tentative force-level goal of 50 SSNs but required a reevaluation of peacetime requirements.
- The Joint Chiefs of Staff 1999 reevaluation determined a force of no fewer than 55 attack submarines was needed.

The end of the Cold War led to significant changes in both the Navy's nuclear-powered ballistic missile submarine (SSBN) and nuclear-powered attack submarine (SSN) forces. During the Cold War, the ballistic missile submarine's basic mission was to remain hidden at sea to deter a nuclear attack on the United States. For this mission, the Navy procured 18 Ohio-class (SSBN-726) submarines, also referred to as Trident ballistic

missile submarines. In 1994, DOD's Nuclear Posture Review¹ concluded that 4 of the 18 Trident SSBNs were no longer needed to support the strategic nuclear mission. Consequently, DOD decided to inactivate rather than refuel the vessels in fiscal years 2003-2004.

The primary stated Cold War mission of the nuclear-powered attack submarine force was to perform anti-submarine warfare missions against the former Soviet submarine force.² To accomplish this mission the force peaked at a Cold War high of 98 nuclear-powered attack submarines at the end of fiscal year 1987³ with the procurement of 62 Los Angeles-class SSN-688 submarines in the 1970s and 1980s. Following the Cold War, the Navy began to increase emphasis on missions that contribute to United States military operations in littoral (near-shore) areas against regional adversaries other than Russia. This led DOD to revise its attack submarine force level goals downward a number of times throughout the 1990s.

In 1997, DOD's Quadrennial Defense Review⁴ established a tentative force-level goal of 50 attack submarines but required a reevaluation of peacetime requirements. The Deputy Secretary of Defense subsequently directed the Chairman of the Joint Chiefs of Staff to determine DOD's attack submarine requirements in 2015 and 2025. In December 1999, the Chairman's study concluded that a force structure below 55 attack submarines in 2015 and 62 attack submarines in 2025 would leave regional military commanders-in-chief with insufficient capability to respond to urgent crucial demands. The study also concluded that 68 attack submarines in 2015 and 76 attack submarines in 2025, were required to meet other high priority but less critical demands. In April 2000, the DOD's Defense Planning Guidance authorized a force of up to 55 submarines taking into account the contributions to conducting attack missions that would be provided by converting up to four Trident SSBNs to an SSGN configuration or refueling selected SSN-688s.

¹ The Nuclear Posture Review, undertaken in 1993, assessed policy, doctrine, force structure, command and control, operations, supporting infrastructure, safety, security, and arms control issues.

² *Navy Attack Submarine Programs: Background and Issues for Congress*, Congressional Research Service, June 2000.

³ *Ship Forces of the U.S. Navy - Historical Force Levels*, Chief of Naval Operations (Resources, Requirements & Assessments), Department of the Navy.

⁴ The Quadrennial Defense Review is a legislatively mandated review of military strategy and the force structure best suited to implement the strategy.



Options for Maintaining Attack Submarine Force Structure


We analyzed four options for maintaining a minimum force structure of 55 attack submarines:

- Option 1: Refueling four SSN-688 attack submarines scheduled for inactivation in fiscal years 2002-2005.
 - Option 2: Refueling four SSN-688 submarines and, upon reaching the end of their operational life after 10-12 years, replacing them with four *Virginia*-class submarines.
 - Option 3: Refueling and converting four Trident SSBNs to SSGNs.
 - Option 4: Refueling four SSN-688 submarines and converting two Trident SSBNs to SSGNs.
-

We analyzed options one and three because they were the primary options DOD was considering when we began our review. Because option 1 would only provide 10-12 years of operational service life after refueling in contrast to the SSGN's 20-22 years of operations, we included a second option that replaces these four refueled SSN-688s at the end of their service lives with four new Virginia-class submarines. We developed a fourth option that refuels four SSN-688s and converts two Trident SSBNs to SSGNs.



Comparison of Refueled SSN-688 and SSGN Characteristics

Characteristic	SSN-688	SSGN
Service life after refueling	10 to 12 years	20 to 22 years
Length in feet	362	560
Displacement in tons ^a	6,900	18,750
Crew	Single	Dual
Comparative size		
^a Submerged displacement		

Source: Our analysis of Navy data.

The SSGNs would be much larger vessels than the refueled SSN-688s and, as a result, could carry more Tomahawk missiles and Special Operations Forces personnel and equipment. The SSN-688s proposed for refueling are early vessels in the Los Angeles-class and were not equipped with the Vertical Launch System for Tomahawk missiles as were later submarines in the class. As a result, the number of Tomahawk missiles the refueled SSN-688 submarines can carry is limited to what can be carried in the torpedo room and the torpedo tubes. Moreover, this space must also accommodate other weapons, further limiting the number of Tomahawks that can be carried. The refueled SSN-688s would not be modified to carry either dry deck shelters⁵ or Advanced SEAL Delivery Systems.⁶ Additionally, because of its limited interior space, a refueled SSN-688 would be able to embark only a limited number of Special Operations Forces personnel for a short period of time.

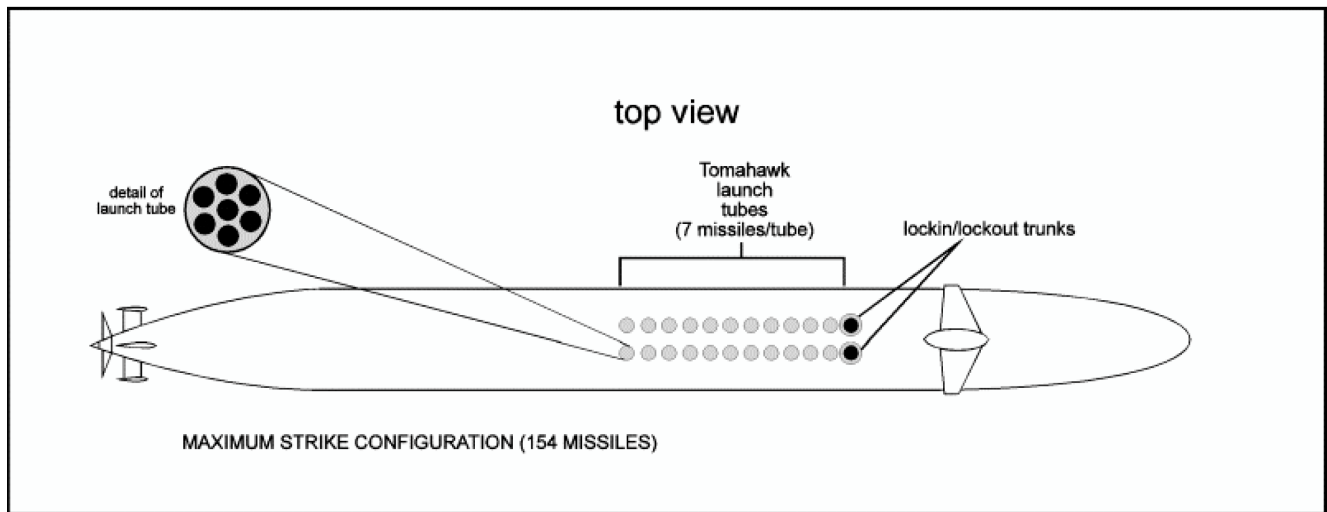
The two types of submarines would use different concepts for crewing. The SSGNs would retain the dual-crewing concept of the Trident SSBNs where each SSGN would have two complete crews assigned. The crews would be rotated half way through each deployment as well as when the submarines are in refit. While one crew serves aboard the submarine, the other trains at shore-based facilities. This would allow the SSGN to be operated more intensely than a submarine with a single crew and extends the time the SSGN could remain overseas. The refueled SSN-688s would have only a single crew, as do the Navy's other attack submarines.

⁵ The dry deck shelter is a deck-mounted cylindrical shelter large enough to house a SEAL Delivery Vehicle or a complement of rubber raiding craft. The shelter allows the submarine to launch and recover Special Operations Forces while submerged. The SEAL Delivery Vehicle is a small submersible that can carry six Special Operations Forces personnel up to 35 nautical miles from the submarine.

⁶ The Advanced SEAL Delivery System is a submersible with a range of 125 nautical miles that can carry up to eight Special Operations Forces personnel and their equipment.



SSGN Can Be Configured to Maximize Strike Capabilities

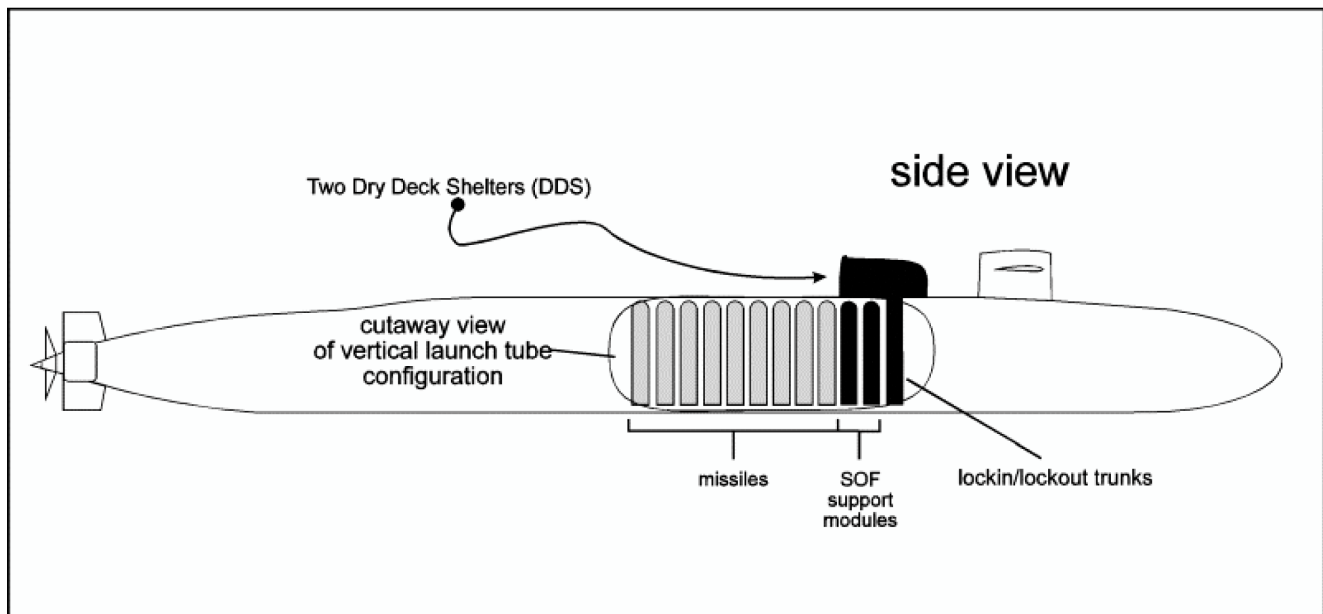


Source: Navy.

The SSGNs would retain the Trident SSBNs' 24 missile tubes. However, in a maximum strike configuration, the SSGN would carry a total of 154 Tomahawk missiles because 22 of the tubes would be adapted to carrying up to 7 missiles per tube. The remaining two tubes would be permanently configured to support Special Operations Forces personnel and equipment and would not be able to carry Tomahawk missiles.



SSGN Can Be Configured to Maximize Special Operations Capabilities



Source: Navy.

To support Special Operations Forces, 2 of the Trident SSBNs' 24 missile tubes would be permanently converted to lockin/lockout chambers.⁷ Special Operations Forces personnel could leave from and return to the submarine while it is submerged through these chambers. Up to eight people could pass through each chamber at a time.

Those two tubes would also serve as the attachment points for the dry deck shelter and the Advanced SEAL Delivery System. The SSGN could carry two dry deck shelters or, potentially, two Advanced SEAL Delivery Systems or one of each. Additionally, when conducting Special Operations Forces missions, up to eight of the missile tubes could be reconfigured to stow Special Operations Forces equipment—leaving the submarine with a capacity for 98 Tomahawk missiles.

⁷ According to Navy officials, because of budgetary and long-lead production considerations, only one lockin/lockout chamber may be installed in each of the first two SSGNs.



Strategic Arms Considerations Could Affect Choice of SSGN Variants

- SSGN options have two variants:
 - Under the accountable variant, submarines would count against START I/II limits on strategic weapons because missile tubes will be modified but not removed.
 - Under the compliant variant, submarines would not count because missiles tubes would be removed.
- Navy's analysis is primarily focused on the accountable variant due to its lower cost and schedule considerations.
- Changes in nuclear/strategic policy being considered by the current administration could render moot any strategic concerns over the conversions.

Although it is not yet in force, the START II treaty will limit the United States to no more than 3,500 strategic nuclear warheads—of which no more than 1,750 may be attributed to submarine-launched ballistic missiles—after December 31, 2007.⁸

The Navy has proposed two variants for the converting Trident SSBNs to SSGNs each of which has different implications under the terms of the Strategic Arms Reduction Treaties (START I and II). Under the START accountable variant, the warheads that the Trident strategic nuclear missiles originally carried aboard the submarines would still count against the United States' START I/II limits because the missile tubes on the submarines would only be modified, not removed. Under the START compliant variant, the submarines would not count against the warhead limits because the original missile tubes designed for the Trident missiles would be removed and smaller tubes incapable of launching any strategic missiles would be installed.⁹

The Navy's analysis has primarily focused on the accountable variant due to cost and schedule considerations. This variant's cost is lower (about 50 percent less than the compliant version according to the Navy's original estimates). Additionally, Navy officials said that insufficient time remains to plan for and acquire the long-lead time material that would be needed to modify the first two Ohio-class Trident SSBNs to a START-compliant SSGN before those submarines must be refueled.

The current administration is considering changes in United States nuclear/strategic policy that could reduce the number of warheads the United States deems necessary to maintain a strong nuclear posture. These changes could reduce concerns over the conversions of the Trident SSBNs to SSGNs.

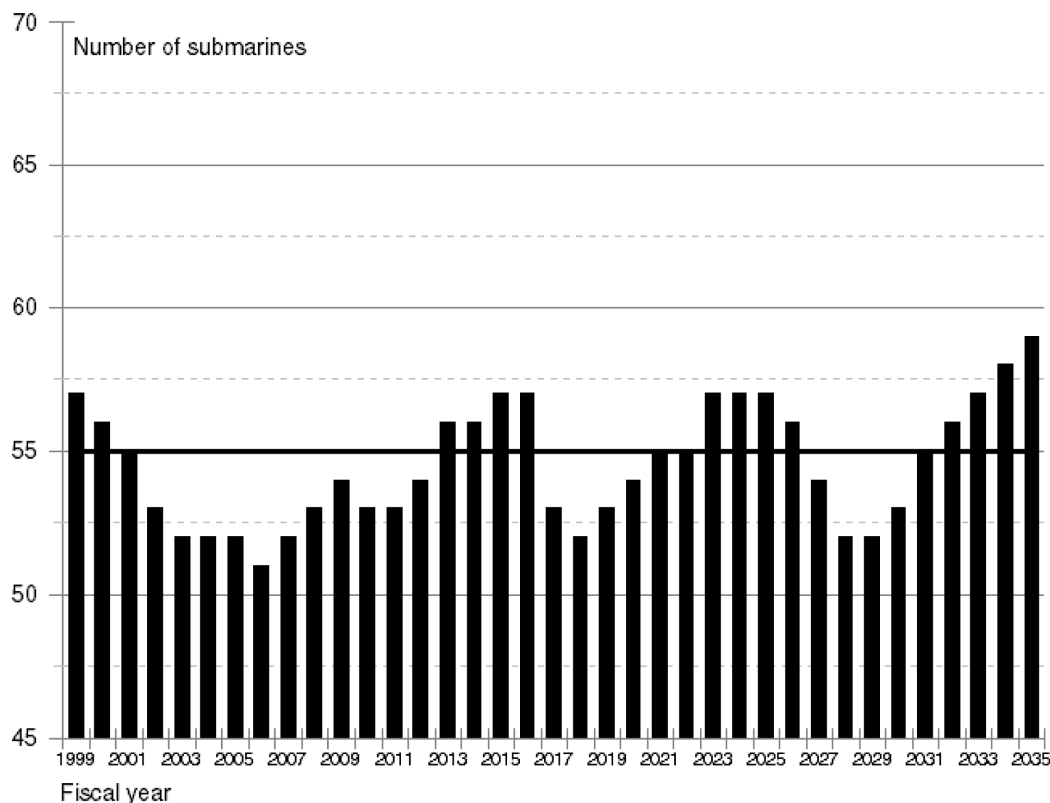
⁸ It is Defense's policy that weapons system programs address pending arms control issues.

⁹ The protocol on procedures governing conversions and eliminations of the START I treaty delineates the elimination procedures.

Briefing Section II: Effect of Options on Force Structure Levels



Baseline: DOD's Planned Attack Submarine Force Structure Without the Options



Source: Our analysis of Navy data.

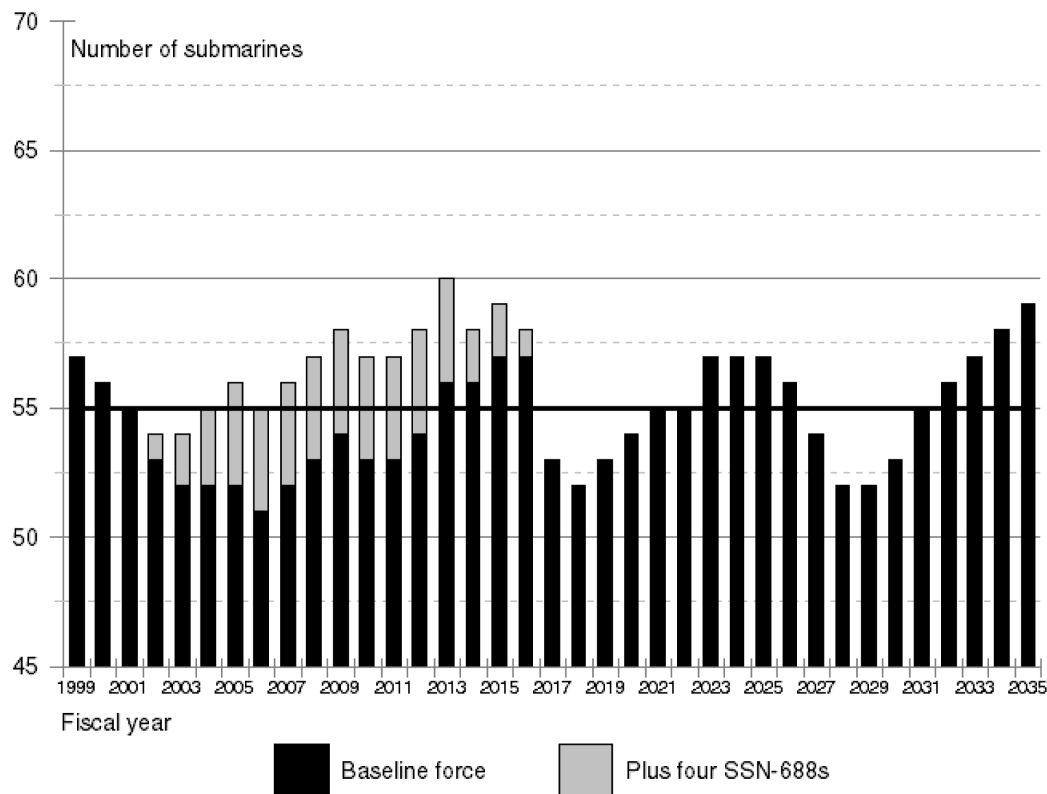
The baseline force shown in this figure reflects the number of submarines included in DOD's 2002 amended budget and DOD's long-range shipbuilding plan¹⁰ but does not include any of submarines associated with the four options we analyzed.¹¹ Unless DOD proceeds with one of these options, it would not have 55 submarines in the force for 19 of 34 years from fiscal years 2002-2035. As noted, the Joint Chiefs of Staff concluded that a force structure below this level would not meet requirements.

¹⁰ *Report on Naval Vessel Force Structure Requirements*, Department of Defense, June 2000.

¹¹ The baseline does not include (1) one SSN-688 refueling and two Trident SSBN to SSGNs conversions that are included in the President's fiscal year 2002 budget request; (2) three SSN-688s that could be refueled in fiscal years 2003, 2004, and 2005; and, (3) two additional Trident SSBNs that have been identified for potential conversion to SSGNs.



Option 1: Refueling Four SSN-688s

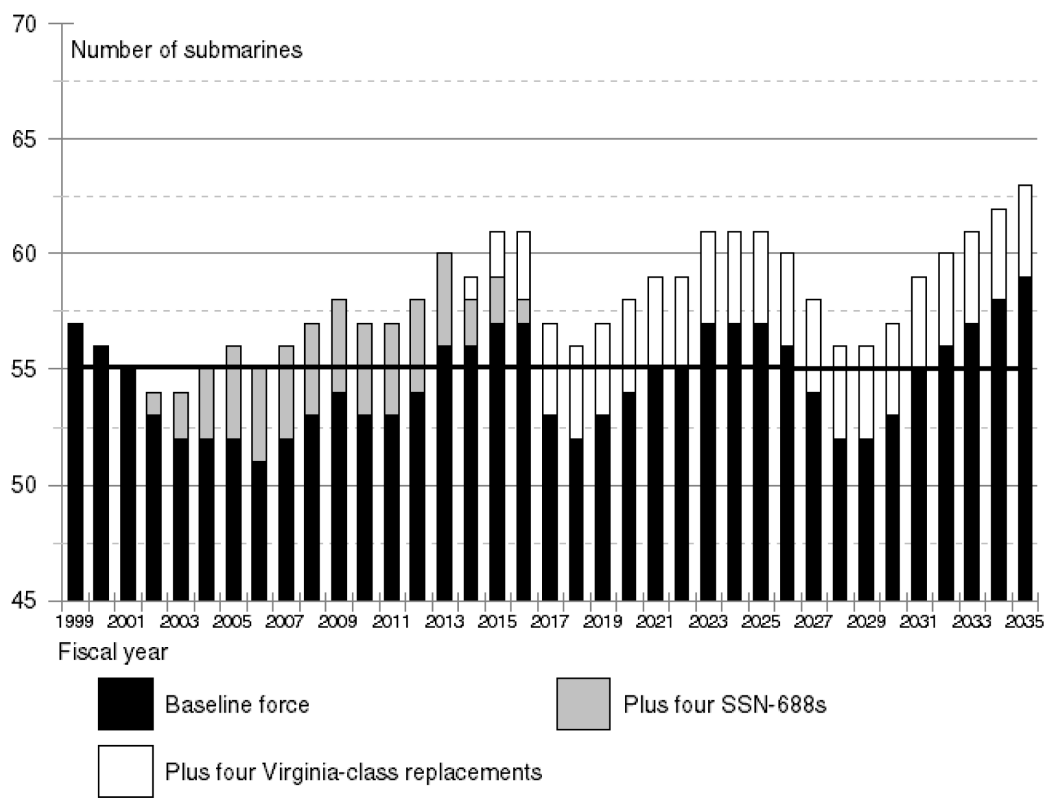


Source: Our analysis of Navy data.

Refueling four SSN-688s would enable the Navy to maintain a force level of 55 submarines for 24 of 34 years in the 2002-2035 time frame. In fiscal years 2017-2020 and fiscal years 2027-2030, the force level would fall below 55 submarines because refueled SSN-688s would have exhausted their useful hull life, and other attack submarines would have reached the end of their useful hull or nuclear reactor core lives.



Option 2: Refueling Four SSN-688s and
Replacing Them with *Virginia*-Class Submarines

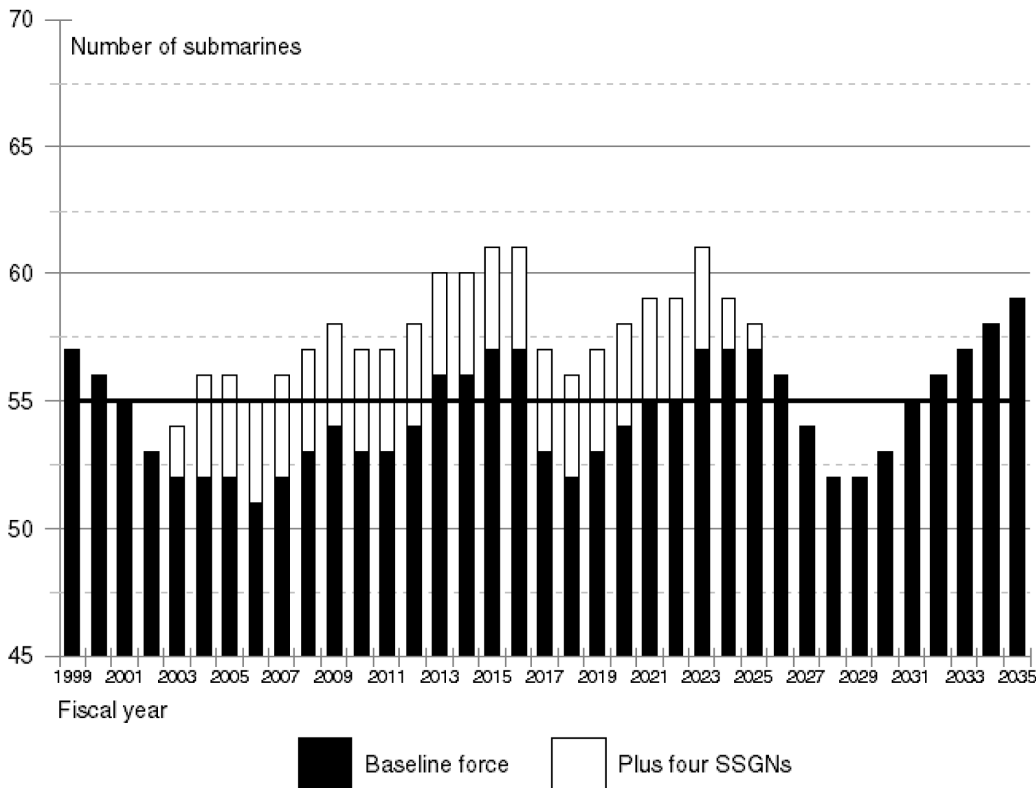


Source: Our analysis of Navy data.

This option (1) provides four refueled SSN-688s and (2) upon their retirement (10-12 years after refueling they reach their 33-year hull life), replaces them with four Virginia-class submarines. These four submarines are in addition to the Virginia-class submarines included in DOD's planned force. The option assumes that the Navy would procure additional submarines upon the retirement of the refueled SSN-688s in order to sustain future force levels. It would enable the Navy to maintain a minimum of 55 submarines in 32 of 34 years during the 2002-2035 time frame—significantly longer than the SSN-688 refueling option alone.



Option 3: Converting Four Trident
SSBNs to SSGNs



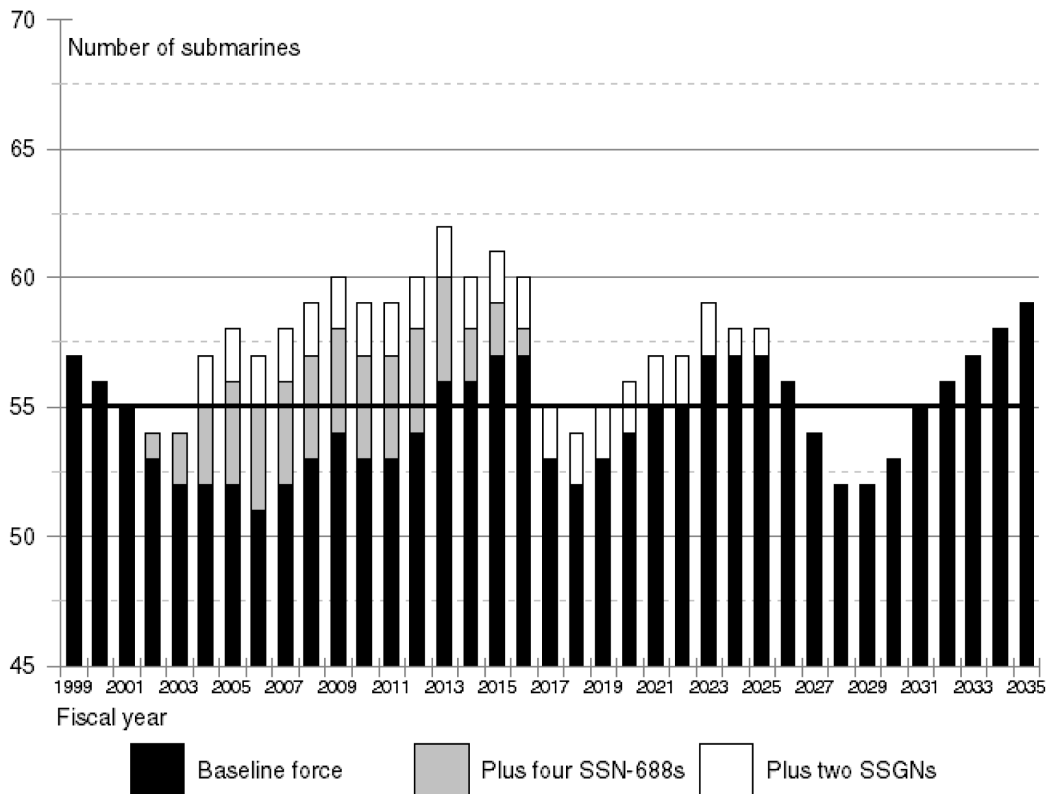
Source: Our analysis of Navy data.

Converting four Trident SSBNs¹² into SSGNs would enable the Navy to sustain a force of at least 55 attack submarines for 28 of 34 years during 2002-2035. This option would not keep pace with planned attack submarine retirements leading to a force of less than 55 submarines during fiscal years 2002-2003 and fiscal years 2027-2030.

¹² With their 42-year service life, Trident SSBNs could, if refueled, overhauled, and converted to a conventional SSGN configuration, remain in service until 2023-2026.



Option 4: Refueling Four SSN-688s and
Converting Two Trident SSBNs to SSGNs



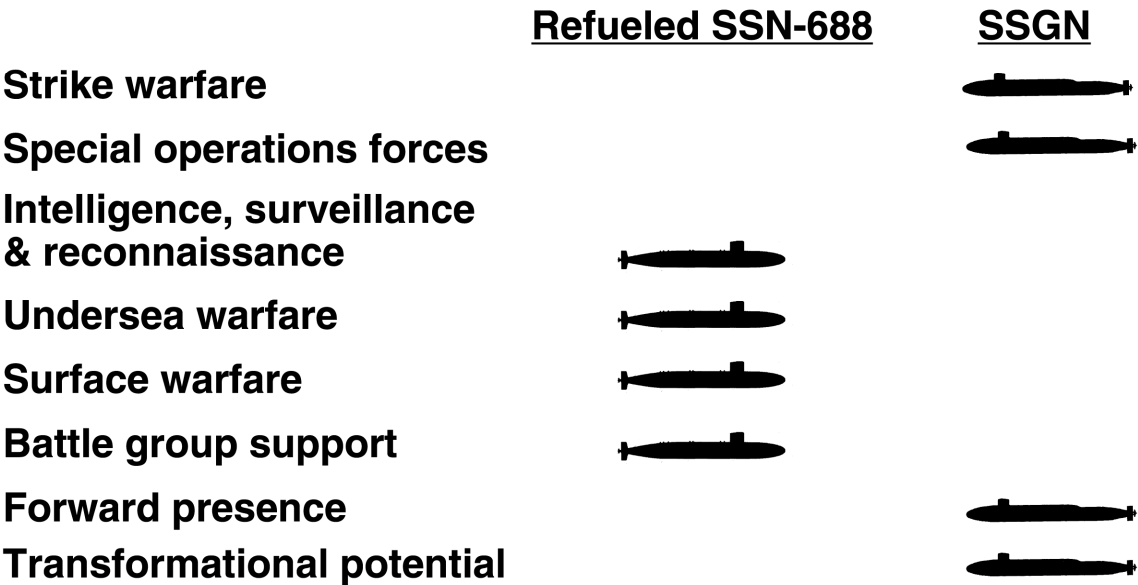
Source: Our analysis of Navy data.

Option 4 would enhance the force by refueling four SSN-688s and funding conversion of two Trident SSBNs to SSGNs. This option would enable the Navy to sustain a force of at least 55 attack submarines for 27 of 34 years during 2002-2035. Funding for the conversion of two additional Trident SSBNs to SSGNs is on the Navy's fiscal year 2002 unfunded priorities list.

Briefing Section III: Comparison of Mission Capabilities and Transformational Potential



Relative Superiority of Options' Mission Capabilities and Transformational Potential



Note: The submarine symbol in this figure indicates which submarine type has superior capability in the designated area.

Source: GAO's analysis.

We compared the capabilities of the refueled SSN-688 and SSGN options in seven mission areas and on their transformational potential. We selected these capabilities because they comprise the primary roles for both the SSN-688 and SSGN, according to Navy officials. We also assessed the submarines' transformational potential. To address specific questions raised by the Subcommittee about Navy capabilities to conduct strike operations, we also compared the respective capabilities of each type of submarine with surface combatants in carrying Tomahawk missiles.

The refueled SSN-688 and SSGN differ in many respects and have different strengths. While these platforms can perform many of the same missions, they would not be viewed as interchangeable and would be assigned different peacetime and warfighting roles. The refueled SSN-688s would be assigned traditional nuclear attack submarine type missions: intelligence, surveillance, and reconnaissance; undersea and surface warfare; and battle group support. SSGN missions would emphasize providing a forward presence of large volume precision strike and Special Operations Forces. In addition, the amount of space available on the SSGN would allow for experimentation with new technologies and concepts and for fielding transformational capabilities in the future.



Strike Warfare: SSGN Provides Superior Strike
Warfare Capability Compared to Refueled SSNs

Capability	Refueled SSN-688	SSGN
Tomahawk capacity	12–26	98–154
Salvo size ^a	4	154

^aSalvo size refers to the number of missiles that can be fired during one engagement or launch operation.

Source: Our analysis of Navy data.

In strike warfare, Navy aircraft and ships attack targets ashore. The Tomahawk missile is a principal strike weapon that submarines, cruisers, and destroyers employ.¹ However, these ships also carry other weapons for other warfare tasks and those weapons compete with the Tomahawk missiles for launcher/magazine space aboard the ships. For example, in addition to Tomahawk missiles, submarines carry torpedoes and mines while cruisers and destroyers carry surface to air missiles.

Compared to the refueled SSN-688s, the SSGNs would provide a superior warfare capability as strike platforms because they would carry more Tomahawk missiles. Depending on the amount and type of special operations equipment carried, an SSGN could carry from 98 to 154 Tomahawk missiles while a refueled SSN-688 could carry no more than 26—all of which must be launched through the submarine's four torpedo tubes—and would typically carry fewer.

SSGNs would also have another advantage in that they could fire all their Tomahawk missiles in one salvo or launch operation. According to Navy officials, doing so can preserve the element of surprise, eliminate the opportunity for the targets to move, and allow a vessel to rapidly attack multiple targets. But, because a refueled SSN-688 launches its Tomahawks from its torpedo tubes, its salvo size is limited to the number of its torpedo tubes—four.

¹ Modern U. S. Navy guided missile cruisers are multi-mission surface combatants capable of supporting carrier battle groups, amphibious forces, or of operating independently and as flagships of surface action groups. The cruisers are equipped with Tomahawk Land Attack Missiles giving them additional long range strike mission capability. Destroyers and guided missile destroyers operate in support of carrier battle groups, surface action groups, amphibious groups and replenishment groups. Destroyers primarily perform anti-submarine warfare duty while guided missile destroyers are multi-mission surface combatants. The addition of the Tomahawk capable vertical launch system to many *Spruance*-class destroyers has greatly expanded the role of the destroyer in strike warfare. The Navy is planning a new destroyer, the *Zumwalt*-class Land Attack Destroyer, that will carry Tomahawks and other missiles.



Strike Warfare: Both SSN-688 and SSGN Have A Covert Strike Warfare Advantage Over Surface Ships

- Both SSN-688s and SSGNs provide a covert strike capability superior to surface ships.
- When compared to surface combatants, SSGNs would
 - free up launcher space on other vessels for other weapons and
 - have a notional load^a comparable to about 3 to 4 cruisers and/or destroyers.
- However, commanders-in-chief and fleet officials expressed concerns about
 - overall shortages of Tomahawk missiles--not launchers and
 - limited flexibility/greater maintenance vulnerability as a result of concentrating many missiles on fewer platforms.

^aUsed for planning purposes, a notional load is the mix of weapons a vessel would typically carry.

As a strike warfare platform, an SSGN and a refueled SSN-688 would have several advantages compared to cruisers and destroyers. Because of its covertness when operating submerged, a potential adversary would not be alerted to an SSGN's or a refueled SSN-688's presence. Additionally, as adversaries become increasingly capable of detecting and attacking U.S. surface ships, an SSGN or a refueled SSN-688 would be less vulnerable to enemy attack than would surface ships.

In addition, converting Trident SSBNs to SSGNs would free up launcher space on other vessels for carrying out other missions. For example, other submarines could carry more torpedoes and cruisers and destroyers could carry more surface-to-air missiles. Also, with an SSGN present, these other vessels, unencumbered by the strike mission, would be able to concentrate on other tasks such as conducting intelligence, surveillance, and reconnaissance operations or maritime intercept operations.

SSGNs would also carry many more Tomahawks than either cruisers or destroyers. Based on notional loads—the mix and number of weapons a vessel carries that is used for planning purposes²—one SSGN can carry as many Tomahawks as three to four cruisers and/or destroyers.

However, officials told us that unless Tomahawk missile inventories are increased the full benefits from the proposed SSGN conversions may not be realized. They stated that DOD's low inventory of Tomahawk missiles is more important to address than the number and capacities of the available Tomahawk launch vessels. Precision-guided munitions top a list of unfunded priorities created by the commander-in-chiefs of the Atlantic and Pacific Fleets. The Navy currently plans to use existing Tomahawk missiles for the SSGNs. It plans to remove most torpedo tube-launched Tomahawks from all submarines to load the SSGNs. These shortfalls will persist under DOD's current budget plans. Moreover, while service officials have not expressed any concerns about a shortage of vessels available to launch Tomahawk missiles, they have expressed concerns over the current Tomahawk inventory shortfalls to include their ability to carryout war plans.

They also pointed out that concentrating more missiles on fewer launch vessels could limit a commander's flexibility in employing the missiles. Additionally, with fewer launch vessels, the impact of a single maintenance failure would be greater.

² In our analysis, we used the same notional loads for surface ships that the Navy uses in its ordnance requirements determination process. We used Navy proposed loads for the submarines. Those proposed loads assume that most torpedo-launched Tomahawk missiles will be withdrawn from all attack submarines.



Strike Warfare: Options' Effect on Navy's Overall
Tomahawk Capability Will Be Small

	Percent change ^{a, b}
With four refueled SSN-688s	1
With four SSGNs	2
With four refueled SSN-688s and two SSGNs	2

^aBased on notional loadouts of all Tomahawk-capable ships in 2010 compared to the currently planned force (does not include the DD-21 Land Attack Destroyer).
^bFour SSGN data assumes torpedo tube-launched Tomahawks are withdrawn from all SSNs. Two SSGN data assumes half the torpedo tube-launched Tomahawks are withdrawn from all SSNs.

Submarines would comprise about 25 percent of the Navy's notional load capability.

Source: Our analysis of Navy data.

From a fleetwide perspective, the effect of the options on the Navy's overall Tomahawk capability would be small. In analyzing Tomahawk capability, we used launcher capability for Navy surface ships and submarines, adjusted for notional weapons loads used by the Navy. Based on notional loads³ and the number and composition of ships expected to be in the fleet in 2010,⁴ fleetwide Tomahawk capability would only increase by about 2 percent if the four SSN-688s were refueled. The four SSGNs would increase fleet-wide Tomahawk capability by about 2 percent. The increase from converting two SSGNs and refueling the four SSN-688s would also be about 2 percent.

Overall, submarines—those attack submarines equipped with the Vertical Launch System and four SSGNs—would comprise about 25 percent of the fleet-wide notional load capability in 2010—about the same percentage as in the current fleet.

³ Our analysis assumes that most torpedo tube-launched Tomahawks are withdrawn from all attack submarines if four Trident SSBNs are converted to SSGNs according to current Navy plans. If only two Trident SSBNs are converted, about half the torpedo tube-launched Tomahawks would be withdrawn. SSN-688s with the Vertical Launch System will still carry Tomahawks.

⁴ Our analysis was based on a planned force of 135 ships and submarines. Because its design has not been definitized, we did not include any DD-21s in our analysis.



Strike Warfare: SSGNs Enhance
Peacetime Presence

SSGNs significantly enhance Tomahawk capability for
peacetime overseas presence.

	Percent change from notional battle group ^b
Notional battle group ^a plus SSGN with full Tomahawk load	64
SSGN with Special Operations Forces load	38

^a A notional battle group consists of two guided missile cruisers, two guided missile destroyers, and two vertical launch system-equipped SSN-688 submarines. A destroyer was not included because only three will be in the force in 2010

^b Assumes most torpedo tube-launched Tomahawks are withdrawn from SSNs.

Source: Our analysis of Navy data.

Our analysis shows that an SSGN with a full Tomahawk strike load (154 missiles) would increase the Tomahawk missiles available in a theater during peacetime by about 64 percent over the number that would be available in a notional carrier battle group alone. If the SSGN was configured to provide a maximum special operations forces capability,⁵ the number of available Tomahawks would increase by about 38 percent.

⁵ The SSGN would carry 98 Tomahawk missiles in this configuration because the special operations forces equipment would displace up to 56 missiles.



Strike Warfare: Wartime Impact of a Four
SSGN Program

While the SSGNs' initial contribution to a major theater war is substantial, its contribution decreases as the war progresses.

Time frame	SSGN portion of Tomahawk loadout capability (percent)
Beginning of war—one carrier battle group plus	
One maximum strike SSGN	44
One maximum strike SSGN and one maximum Special Operations Force SSGN	56
Mature theater (follow-on carrier battle groups plus third SSGN)	21

Note: The comparison (1) assumes that the ships and submarines initially engaged do not replenish their original Tomahawk loads, (2) does not account for other Tomahawk-capable ships and submarines that may be in the theater, and (3) assumes most torpedo tube-launched Tomahawks are withdrawn from SSNs.

Source: Our analysis of Navy data.

A force of four SSGNs would make a substantial initial Tomahawk contribution to a major theater war, but its contribution would decrease as the war progresses. As a “survivable” strike weapon,⁶ Tomahawks would be heavily engaged in a conflict’s opening stages, primarily attacking and degrading the adversary’s air defense system, thus reducing the risk of loss of U.S. manned strike aircraft. However, Tomahawk’s role would diminish as the war progresses because the targets would become more suitable for attack by manned strike aircraft.

If, at the beginning of a conflict, one carrier battle group⁷ and one SSGN with a maximum strike load of Tomahawk missiles were present in the theater, we estimate that the SSGN would provide about 44 percent of the total Tomahawks available. If warning was sufficient to allow a second SSGN⁸ to deploy to the region before the conflict started, the two SSGNs would carry about 56 per cent of the total number of Tomahawks available to the theater commander when the conflict started.

As the war progresses, additional U.S. forces would flow into the theater. These forces would include several additional carrier battle groups and could include a third SSGN (in the maximum strike configuration). That SSGN would carry about 21 percent of the Tomahawks the additional forces would bring into the theater.⁹

⁶ The Air Force’s B-2 bomber and F-117 fighter are also “survivable” strike weapons.

⁷ Our analysis is based on the same notional carrier battle group we used earlier—two guided missile cruisers, two guided missile destroyers, and two VLS-equipped SSN-688 submarines.

⁸ We assumed the second SSGN would be configured for special operations forces operations and, thus, would have a load of 98 Tomahawk missiles.

⁹ This assumes that the ships and submarines initially engaged do not replenish their original Tomahawk loads after firing all their missiles and does not take in to account the missiles on other Tomahawk-capable ships and submarines that may be in the theater.



Strike Warfare: Wartime Impact of a Two
SSGN Program

While the SSGNs’ initial contribution to a major theater war is substantial, its contribution decreases as the war progresses.

Time frame	SSGN portion of Tomahawk loadout capability (percent)
Beginning of war—one carrier battle group plus	
One maximum strike SSGN	44
One maximum strike SSGN and one maximum SOF SSGN	A second SSGN is less likely to be able to surge to a theater before the outbreak of hostilities than with a four SSGN force.
Mature theater (follow-on carrier battle groups plus second SSGN in SOF configuration)	15

Note: The comparison (1) assumes that the ships and submarines initially engaged do not replenish their original Tomahawk loads, (2) does not account for other Tomahawk-capable ships and submarines that may be in the theater, and (3) assumes most torpedo tube-launched Tomahawks are withdrawn from SSNs.

Source: Our analysis of Navy data.

A two SSGN force's contribution to a major theater war would be less substantial than that of a four-SSGN force—both in the initial phase and as additional forces flow into the theater. A maximum strike configured SSGN operating with a carrier battle group would still provide about 44 percent of the total Tomahawk missiles available at the beginning of the conflict. But with only two SSGNs in the force, it would be less likely that a second SSGN, in either a strike or Special Operations Forces configuration, would be able to deploy to the region by the start of the conflict. Thus, either fewer Tomahawks would be available for the initial strikes of the conflict or other vessels would have to be tasked to carry the Tomahawks that a second SSGN would have carried.

Assuming that the second SSGN deploying to the theater with the additional carrier battle groups would be configured for special operations forces, it would carry about 15 percent of the Tomahawks the additional forces would bring into the theater.¹⁰

¹⁰ This assumes the theater commander wanted one SSGN configured for strike and the other configured for special operations.



Special Operations Forces: SSGNs Would Provide Capability Superior to Refueled SSN-688s

- SSGNs will be modified to carry SOF dry deck shelters and delivery vehicles whereas refueled SSN-688s will not.
 - SSGNs will have larger space for SOF personnel, mission planning, physical fitness, and equipment storage, which would enable more sorties and on-station days.
 - SSGNs are the only option to replace the multiple mission SOF capability that will retire with the U.S.S. *Kamehameha* in October 2001.
-

United States special operations forces operate in hostile, denied, or politically sensitive areas to conduct a range of special operations, such as seizing and destroying weapons of mass destruction and striking targets deep within enemy areas. To conduct these operations, special forces are inserted into an area by fixed-wing aircraft, helicopter, surface craft, or submarines; however, only submarines provide a highly clandestine insertion platform that can remain on station for weeks at a time.

The SSGN would provide special operations forces capability superior to that of the refueled SSN-688s. The SSGN's larger space for special operations forces personnel, mission planning, physical fitness, and equipment storage would enable special operations forces to remain on station for about 90 or more days as opposed to the 14 days provided by a refueled SSN-688.

Because of their limited remaining hull life and technical considerations with the older submarines, Navy officials told us the refueled SSN-688s would not be modified to carry dry deck shelters or Advanced SEAL Delivery Systems and they would only provide a marginal special operations forces capability. Furthermore, the refueled SSN-688s would be the older ones of their class, with limited available space for upgrades, older combat systems, and greater acoustic signature.

The SSGN would provide the only option to replace the dual dry deck shelter capability lost with the inactivation of the U.S.S. *Kamehameha* in October 2001.¹¹ Dual host capability provides a long endurance, stealthy, mobile operating base for conducting multiple special operations forces missions over an extended period of time. Although a limited number of SSN-688 submarines have been modified to carry one dry deck shelter or Advanced SEAL Delivery System, a DOD study notes that an SSGN with two Advanced SEAL Delivery Systems could conduct 50 percent more missions than two SSNs with a single Advanced SEAL Delivery System.¹²

¹¹ The U.S.S. *Kamehameha* is a ballistic missile submarine that has been modified to carry two dry deck shelters and special operations forces.

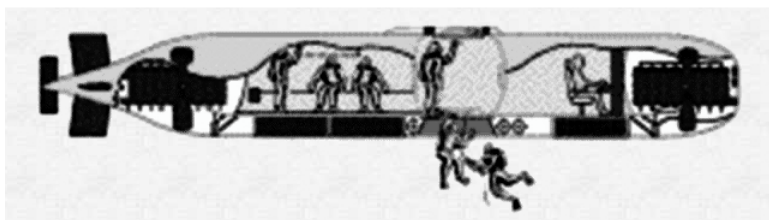
¹² *Analysis of Converting Trident-Class Ballistic Missile Submarines (SSBNs) to Nuclear-Powered Guided-Missile Submarines (SSGNs)*, Office of the Secretary of Defense, Final Report, March 1999.



Special Operations Forces: SSGN Option Would Include Modifications for Special Operations



(left) The SEAL Delivery Vehicle has limited endurance, wet compartments, and can operate in shallow water.



(left and above) The Advanced SEAL Delivery System has extended endurance, dry compartments, and operates in deeper water.

Source: Navy.

In converting to the SSGN design, the Trident SSBN would be modified to carry two dry deck shelters, two Advanced SEAL Delivery Systems,¹³ or one of each. The dry deck shelter is a large steel structure attached to the outside of specially configured submarines. It can be used to transport and launch a SEAL Delivery Vehicle or to lockout special operations forces personnel. The SEAL Delivery Vehicle is a small, wet, battery-powered submarine that is stowed in, and launched from the dry deck shelter. It operates in shallow waters near the coastline. The SEAL Delivery Vehicle is termed a wet submarine since the interior, containing the crew and cargo, is fully flooded during submerged operations. Crew and passengers wear scuba gear or use the SEAL Delivery Vehicle's auxiliary life support system during transit. Because SEALs are exposed to the water, they have limited endurance while in the SEAL Delivery Vehicle.

The Advanced SEAL Delivery System is a small dry battery powered submarine that can clandestinely insert special operations forces. The Advanced SEAL Delivery System will eliminate diver exposure to water temperatures during transit; have significantly greater range, operating depth, and loiter capabilities; and carry more special operations forces than the SEAL Delivery Vehicle. Currently, the Advanced SEAL Delivery System is undergoing testing.

¹³ Further tests must be conducted before a final decision can be made to provide the SSGNs with a dual-Advanced SEAL Delivery System capability.



Special Operations Forces: Special
Operations Forces Capabilities

Capability	Refueled SSN-688	SSGN
Ability to conduct Drydeck Shelter operations	No	Dual
Ability to conduct Advanced SEAL Delivery System operations	No	Dual
Personnel supported	None	66 (102 surge)
SOF at-sea sustainability (days)	14 ^a	90
Lock-out chamber (persons)	No (escape trunk only)	Yes (up to 8)
Dedicated mission readiness facilities	No	Yes

^aSpecial Operations Command officials told us there are no plans to support SOF on the refueled SSN-688s; however, under certain circumstances SOF could be embarked on them for a limited period of time.

The SSGN's special operations forces capabilities exceed those of the refueled SSN-688s on every measure of mission effectiveness. Special Operations Command officials stated that these older SSNs are not expected to be used for special operations forces operations because they will not be modified to carry either a dry deck shelter or Advanced SEAL Delivery System. They could, however, embark one special operations forces platoon of 16 personnel in a crisis for 14 days. In contrast, the SSGN would normally carry 66 special operations forces personnel for about 90 days and could surge to 102 for short periods of time, if needed. The SSGNs extended endurance would allow them to conduct multiple special operations forces missions. The SSGNs would be equipped with up to two 9-man lock-out chambers¹⁴ while the SSNs would only possess an escape trunk that can be used by two to three personnel at a time without their specialized equipment. The SSNs would lack dedicated mission readiness facilities such as: crew berthing, physical fitness, and mission planning space crucial to sustaining special operations forces for extended periods of time.

¹⁴ The chamber has capacity for nine people but one person is an operator.



Intelligence, Surveillance, And
Reconnaissance

- Refueled SSN-688s would have better Intelligence, Surveillance, and Reconnaissance capability, but SSGNs would provide a good capability.
 - Refueled SSN-688s would provide better capability for identifying other submarines and for intercepting communications and determining their bearing.
 - SSGNs would have better antennas and modularity capability for sharing data and accepting new and improved technology.
-

Submarines provide a critical intelligence-gathering capability unavailable through other national assets. With their multiple sensors, submarines can monitor events in the air, on the surface, or subsurface littoral areas and can collect a wide variety of intelligence data, including acoustic, signals, visual, and environmental information. Submarines also serve as a “force-multiplier,” by alerting other assets to high interest events. Since submarines can operate in areas inaccessible to other platforms or systems, they can intercept signals of crucial importance to unfolding international events. Moreover, a submarine’s ability to loiter for extended periods of time allows it to collect vital information without alerting adversaries to modify their behavior.

According to Navy officials, the refueled SSN-688 would be a more capable intelligence collection platform than the SSGN. The refueled SSN-688 would have better acoustic and signals intelligence capability to identify the sound signatures of other submarines and to direct, intercept, and determine the bearing of communications. The refueled SSN-688s would also have the low-band sensors for close-in missions that the SSGN would not have. The refueled SSNs and SSGNs would have an equal ability to be upgraded to observe visual phenomenon such as tests above the sea’s surface that would otherwise elude national systems and to use sonar to image the ocean floor, identify mines, and conduct intelligence preparation of the battlefield.

Navy officials further stated that although the SSGN would not be as capable an intelligence, surveillance, and reconnaissance platform as the refueled SSN-688s, it would remain extremely quiet and would have an inherent intelligence, surveillance, and reconnaissance capability. The SSGN could be called upon to perform certain intelligence, surveillance, and reconnaissance missions, as was the converted ballistic missile submarine U.S.S. *Kamehameha*. Because of its size, the SSGNs’ antennas and modularity¹⁵ would be superior to the refueled SSN-688s. As such, the SSGN would have a better capability to share data than the refueled SSN-688 and to accept new and improved technology and sensors. However, the SSGN would have less capability to perform acoustic and signals intelligence gathering.

¹⁵ Modular construction uses standardized units or dimensions for flexible use. Use of modular design techniques, open architecture, and commercial off-the-shelf components permits rapid, less expensive modernization of submarines.



Undersea Warfare: SSN-688s Provide Greater Capability

- Greater torpedo capacity provides superior Undersea Warfare capability for the refueled SSN-688 although the SSGN would have a strong capability.
 - Undersea warfare is a primary SSN mission and a secondary SSGN mission; however, refueled SSN-688 and SSGN crews would be trained to same standard.
 - Refueled SSN-688 acoustic sensors will be better than those of SSGN.
 - SSN-688s can be equipped for mining and mine warfare. No current plans to assign mine warfare missions to SSGN, although future potential exists with Unmanned Underwater Vehicles.
-

Undersea Warfare includes detecting and destroying enemy submarines (antisubmarine warfare) and laying and countering enemy mines (mine warfare). According to Navy officials, the refueled SSN-688s would provide a greater undersea warfare capability than the SSGNs because they would have a better acoustic sensor suite and they would be able to carry more than twice the number of torpedoes as an SSGN;¹⁶ however, the SSGNs' size, flexibility, and growth volume make them ideal platforms for new initiatives in undersea warfare. Crews of the SSN-688s and SSGNs would be trained to the same undersea warfare standard, but, according to Navy officials, undersea warfare would be a primary mission for the refueled SSNs and a secondary mission for the SSGNs.

The refueled SSN-688s' sensors for identifying other submarines and for intercepting communications and determining their bearing would be slightly better than those on the SSGNs. According to Navy officials, the Navy has a limited number of mines and equipment necessary to allow submarines and other ships to lay them; however, because of this shortage, SSNs are not typically configured to conduct these operations. Although the SSGN could be modified to lay mines, the Navy does not plan to use it to do this. The SSGN would not be able to carry as many mines as the refueled SSN-688 due to its smaller torpedo room. Even though the Navy does not plan to use the SSGN for mine warfare missions, it has the potential for launching unmanned underwater vehicles, which are stored and launched from a submarine's missile tubes. These vehicles would allow submarines to covertly detect and report dangerous mine areas without risk to other naval forces. The SSGNs would have more available space than the refueled SSN-688s for using this technology.

¹⁶ Depending on their mission, submarines deploy with a mix of torpedoes, Tomahawk cruise missiles, and mines. Torpedoes are the Navy's principal weapons for destroying enemy submarines.



Surface Warfare: SSN-688s Provide Greater Capability

- Greater torpedo capacity provides superior surface warfare capability for the refueled SSN-688 although the SSGN would have a strong capability.
- Surface warfare would be a primary SSN mission and a secondary SSGN mission; however, refueled SSN-688 and SSGN crews would train to the same standard.
- Refueled SSN-688s and SSGNs would have similar surface warfare sensor capabilities.

Surface Warfare involves detecting and destroying enemy surface ships. To detect and destroy surface ships, submarines are equipped with advanced sensors and weapon systems. According to Navy officials, the refueled SSN-688 and the SSGN would have similar sensors, but the refueled SSN-688 would have a larger torpedo room and would be able to carry twice as many torpedoes as the SSGN. While the crews of the refueled SSN-688s and SSGNs would be trained to the same standard, Surface Warfare would be a primary mission for the refueled SSN-688s and a secondary mission for the SSGNs.



Battle Group Support Operations:
SSN-668s Better Suited Than SSGNs

- Battle group operations are a primary SSN-688 mission. SSGNs are less likely to be routinely deployed in this role.
- SSGNs have many of the basic capabilities but are not as well equipped for conducting support missions such as undersea warfare.
- A SSN-688's speed is more comparable to a carrier battle group's speed than is a SSGN's speed.

A carrier battle group is a combat formation of ships and aircraft formed to provide a balanced force that would be capable of dealing with a variety of threats. The collective capabilities of the battle group would allow it to carry out tasks such as supporting peacetime presence requirements, maintaining control of designated airspace areas, and projecting power ashore. Carrier battle groups are comprised of similar types of ships, typically including an aircraft carrier, two guided missile cruisers, a guided missile destroyer, a frigate, two attack submarines, and a supply ship.

Battle group support operations are a primary nuclear-powered attack submarine mission, and two typically deploy with each battle group. Refueled SSN-688s would provide protection, surveillance, and intelligence support to the battle group and their torpedoes contribute to the battle group's defense against enemy submarines and surface ships. In addition, the speed of the SSN-688s is more comparable to the speed of the carrier battle group.

The SSGNs would not routinely be used to provide continuous battle group support. While the SSGN would have many of the necessary capabilities to conduct these operations, Navy officials told us that the SSGN would be employed as a "theater asset" reporting directly to the regional commander in chief and not in direct support of the battle group commander. Moreover, the SSGN would not routinely be scheduled to deploy with carrier battle groups but instead would remain on deployment for extended periods.

Further, with its massive load of Tomahawk missiles and special operations forces personnel, the SSGN is best suited to perform strike and special forces missions. As such, officials stated that it would not be prudent to place its large weapons load at risk in conducting battle group support operations for which it is not ideally suited.



Forward Presence Capability: SSGNs Would Provide Superior Forward Presence Capability

- SSGN's dual crews and maintenance plan provide greater forward presence.
- Four SSGNs would provide 2.65 submarines forward deployed in 3 areas of operation.
- Two SSGNs would provide 1 submarine forwardly deployed in one area of operation.
- Four Refueled SSN 688s would provide 0.8 submarines forwardly deployed each year.

The extent to which submarines would actually be forward deployed in a theater of operations is referred to as "presence." Forward presence activities include mission operations (e.g., intelligence gathering, surveillance, and missile patrols), engagements and exercises with U.S. and multinational units, maintenance performed while forwardly deployed, port visits, and inter-and intra-theater transits.

While either refueling four SSN-688s or refueling and converting four Trident SSBNs to SSGNs would add four submarines to the fleet, the options do not provide equal forward presence capability. The dual crewing of the Trident force would enable four SSGNs to provide more forward presence than four refueled SSN-688s.¹⁷ A DOD analysis concluded that 8-10 single-crew ships (such as the SSN-688s being considered for refueling) would be required to provide the same level of forward presence capability as four dual crewed SSGNs.¹⁸

According to an analysis performed for the Navy, a fleet of four SSGNs could provide on average a total 2.65 submarines deployed in three theaters and the flexibility to surge from theater to theater.¹⁹ In contrast, four refueled SSN-688s would provide less than one submarine forwardly deployed. The Navy has not fully analyzed the forward presence coverage that a force of two SSGNs would provide. However, officials note that two ships can only provide continuous presence in one theater and that employing only two SSGNs reduces schedule flexibility. In addition, the two SSGN option would reduce the availability of the SSGN to free up other naval forces such as destroyers and attack submarines for higher priority missions such as theater ballistic missile defense, anti-air warfare, intelligence, surveillance, and reconnaissance, and sea control. Furthermore, officials told us that it would make economic and logistical sense to base a force of two SSGNs in one homeport rather than a homeport on each U.S. coast. However, basing two SSGNs on a single coast would mean that either the Pacific or European theaters would not routinely reap the deployment benefits of the SSGN.

¹⁷ The SSGN's concept of operations is a preliminary estimate based on the Trident SSBN and attack submarine historical deployment structures and maintenance patterns, the Trident submarine's high deployment tempo and extended deployments demonstrated in a series of strategic submarine exercises called Submarine Continuity of Operations. For further information, see *Analysis of Converting Trident-Class Ballistic Missile Submarines (SSBNs) to Nuclear-Powered Guided-Missile Submarines (SSGNs)*, Office of the Secretary of Defense, Final Report, June 1999.

¹⁸ *Analysis of Converting Trident-Class Ballistic Missile Submarines (SSBNs) to Nuclear-Powered Guided-Missile Submarines (SSGNs)*, Office of the Secretary of Defense, Final Report, March 1999.

¹⁹ *Trident SSGN Marginal Utility Analysis: 2010 Peacetime Presence*, Center for Naval Analyses, March 2001.



Forward Presence Capability: Comparison of Submarine Presence

	Refueled SSN-688	SSGN
Service life (in years)	10-12	20-22
Presence days per year	73	242
Number of submarines	4	4
Total presence days provided per year	292	968
Tomahawk missiles per submarine	12	98-154
Average number of Tomahawks per day in- theater	10	334
SOF platoons per submarine^a	0-1	4-6
Average number of SOF platoons per day in- theater^a	0-0.8	14

^a Refueled SSN-688s can surge up to one platoon for a limited duration and SSGNs can surge up to 6 platoons for more extended durations.

Source: Our analysis of Navy data.

The SSGN's presence capabilities exceed those of the SSN-688s proposed for refueling. Each SSGN would provide 242 presence days per year for a total of 968 days for a force of four SSGNs. In contrast, a refueled SSN-688 would provide only 73 presence days per year or 292 presence days for a force of four SSNs.

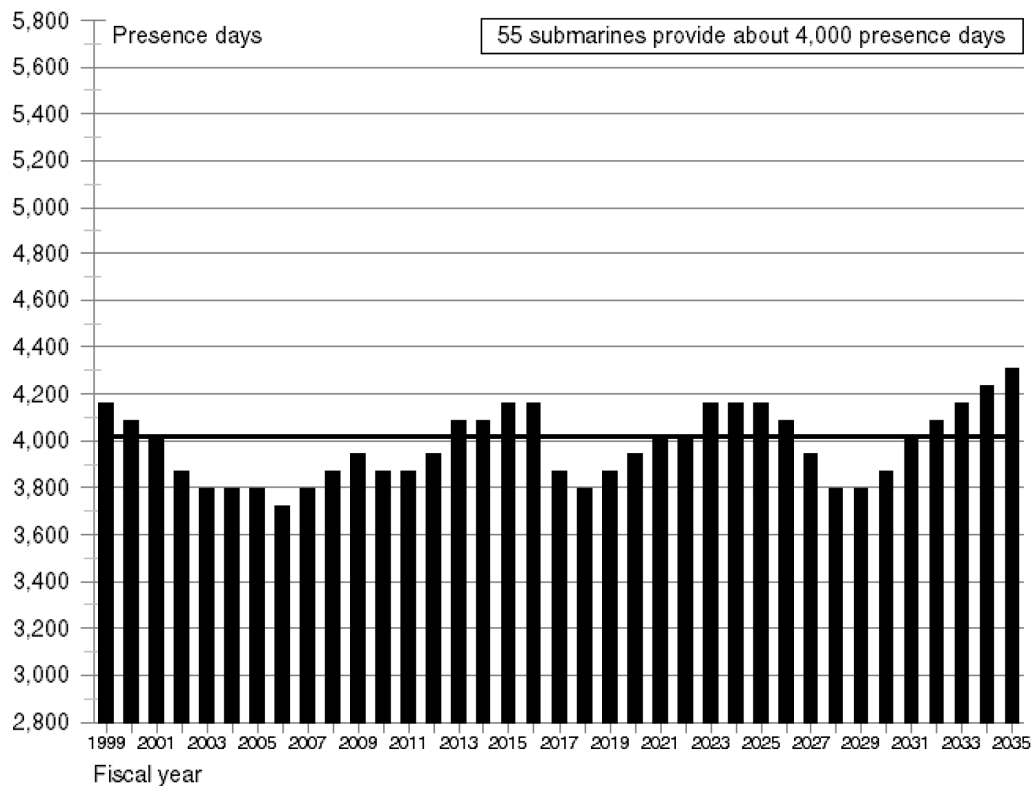
As noted earlier, the SSGN would provide vastly greater Tomahawk presence days with an average of 334 Tomahawks per day in-theater for a four SSGN force.²⁰ In contrast, four refueled SSN-688s would only provide an average of 10 Tomahawks per day in-theater at any given time.

Similarly, four SSGNs would provide an average of 14 special operations forces platoons in-theater. In contrast, refueled SSN-688s could surge up to one platoon for a limited duration.

²⁰ This assumes a load of 98 and 154 Tomahawk missiles in the special operations and maximum strike configurations, respectively.



Forward Presence Capability:
Presence Days For Baseline Force Without the Options



Source: Our analysis of Navy data.

In December 1999, the Chairman's study concluded that a force structure below 55 attack submarines in 2015 and 62 attack submarines in 2025 would leave regional military commanders-in-chief with insufficient capability to respond to urgent crucial demands. A force of 55 attack submarines provides just over 4,000 days of presence in overseas theaters each year (an attack submarine provides 73 presence days annually) and 62 attack submarines would provide about 4,500 presence days. The study also concluded that 68 attack submarines in 2015 and 76 in 2025, were required to meet other high priority but less critical demands. These force levels would equate to 5,000 and 5,500 presence days, respectively.²¹

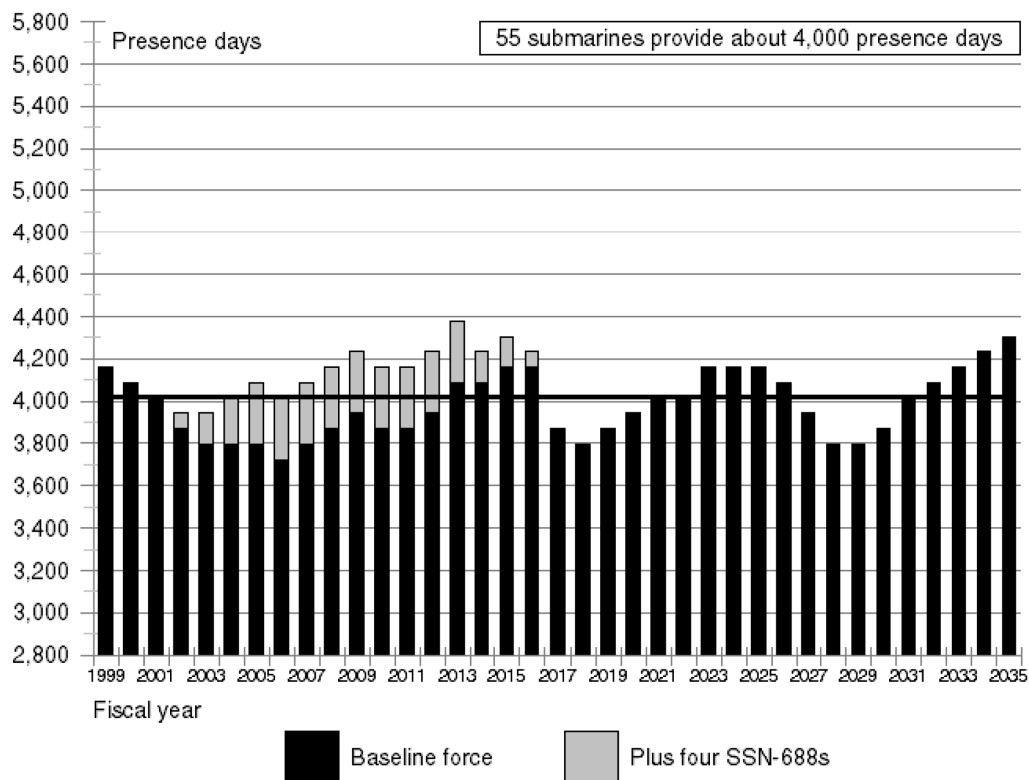
Our review did not evaluate the validity of the study's force structure recommendations, although we did examine the extent to which the proposed options would help DOD achieve the lower of these goals established by this study.

Without additional submarines the baseline force would not meet attack submarine presence day goals for 19 years between 2002 and 2035.

²¹ We rounded presence days to the nearest hundred.



Forward Presence Capability Option 1: Presence Days For the Baseline Force Plus Four Refueled SSN-688s

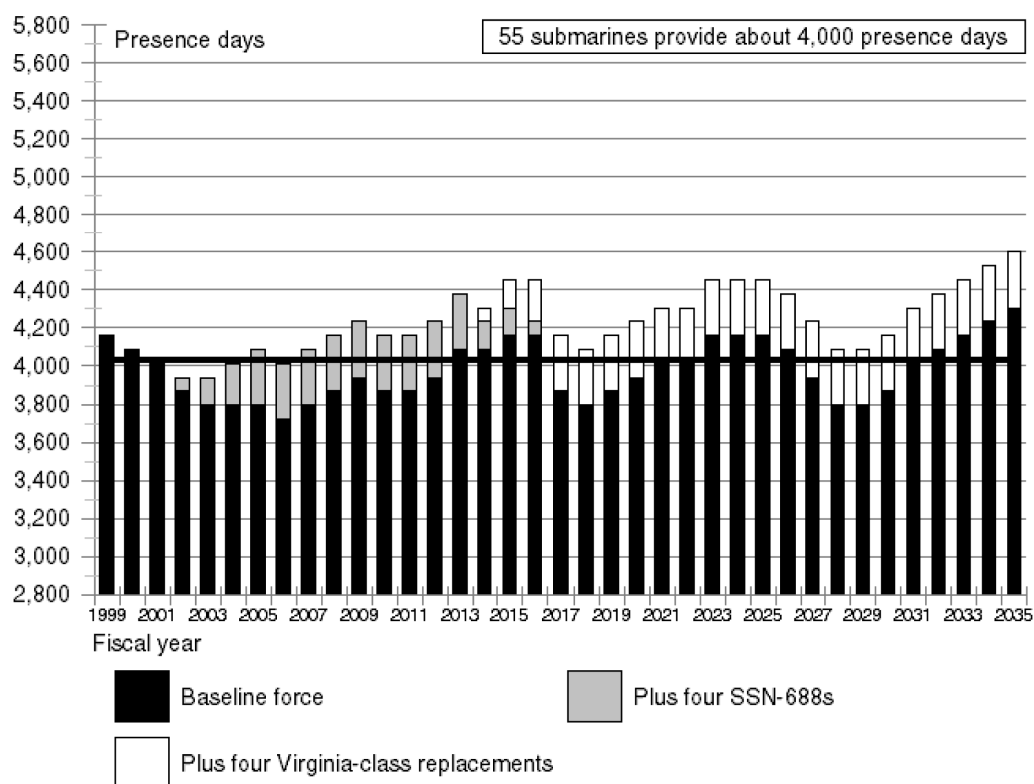


Source: Our analysis of Navy data.

Of the proposed options, refueling four SSN-688s contributes the least toward meeting DOD's presence day goals. This option helps DOD to achieve its presence day goals for 9 additional years (from 2004 to 2012) above that provided by the baseline force. However, DOD would still be unable to meet its presence day goals for 10 years between 2002 and 2035.



Forward Presence Capability Option 2: Presence Days for the Baseline Force Plus Four Refueled SSN-688s and Four *Virginia*-Class Replacements

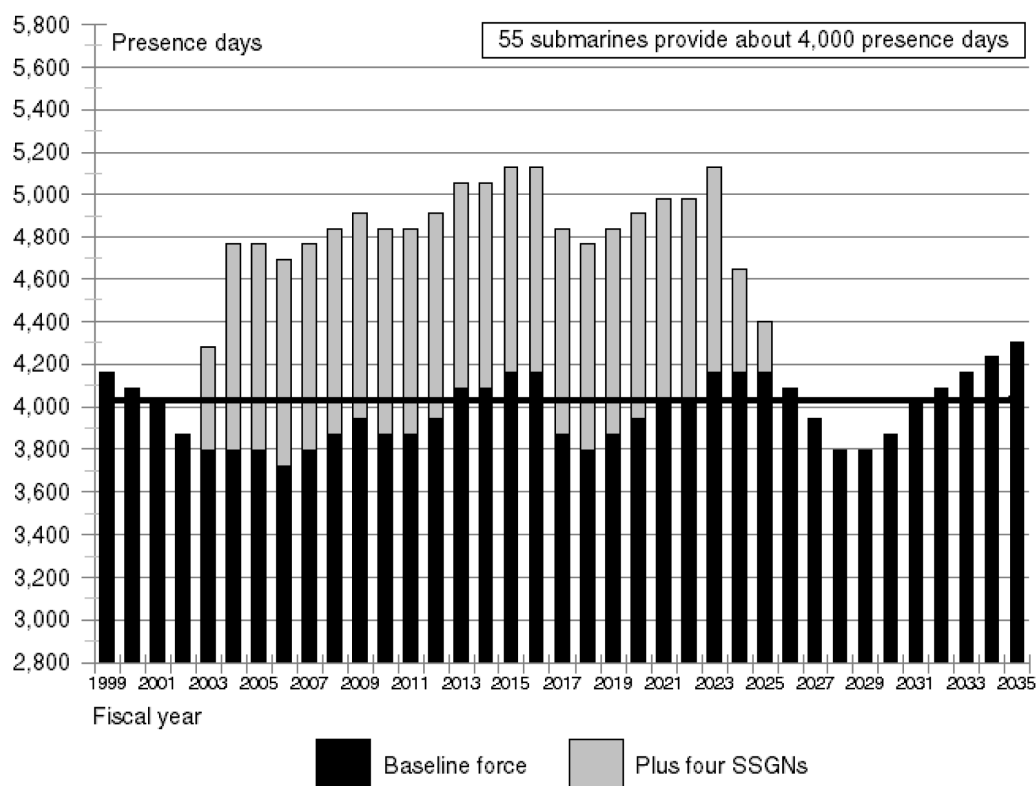


Source: Our analysis of Navy data.

Refueling four SSN-688s and replacing them with Virginia-class submarines helps DOD achieve its presence day force structure goals for 17 additional years over that provided by the baseline force. DOD would be unable to meet its presence day goals in only 2002-2003. This is the only option that would have no presence day gaps between 2004-2035.



Forward Presence Capability Option 3: Presence Days for the Baseline Force Plus Four SSGNs

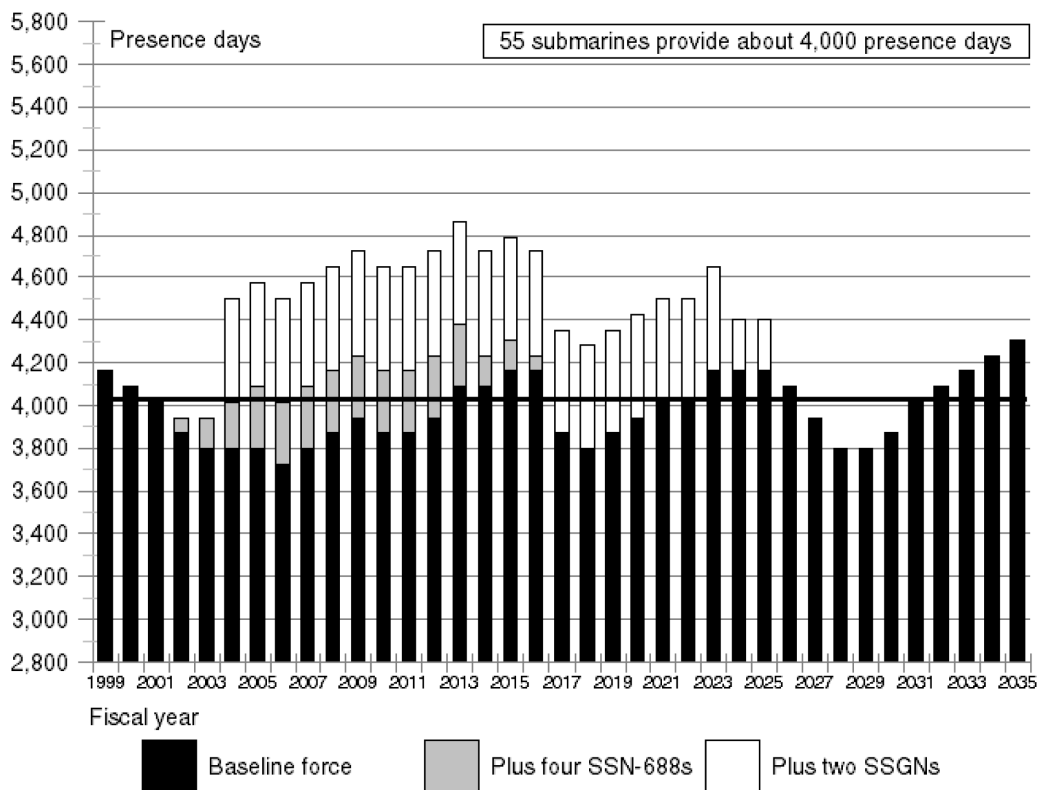


Source: Our analysis of Navy data.

Of the proposed options, converting four Trident SSBNs to SSGNs contributes the most presence days and helps DOD achieve its presence day goal for 14 additional years over that provided by the baseline force. With the four SSGN option, DOD would fall short of its presence day goal for only 5 years (between fiscal year 2002 and 2035).



Forward Presence Capability Option 4: Presence Days For Baseline Plus Four SSN-688s and Two Trident SSGNs



Source: Our analysis of Navy data.

Option 4 would enhance the submarine force by refueling four SSN-688s and converting two Trident SSBNs to SSGNs. This option helps DOD achieve its presence day goals for 13 additional years over that provided by the baseline force. However, DOD would fall short of its presence day goal for 6 years (fiscal years 2002 and 2003 and fiscal years 2027 to 2030).



Transformation: SSGNs Would Provide Superior Transformation and Experimentation Capability

- SSGN's size would allow for upgrades and experimentation with new technologies and weapons (e.g., unmanned aerial vehicle, unmanned underwater vehicles, and communications and antennas).
 - Refueled SSN-688s' have shorter hull life and limited space for upgrades which limits its potential for transformation and experimentation.
 - SSGNs could free-up other platforms for missions such as anti-air, theater missile defense, and undersea warfare.
-

One goal of naval transformation efforts is to counter challenges expected in the future. One of the challenges facing the Navy is the use of anti-access or area denial strategies by potential adversaries. Such strategies aim to deny U.S. forces access to the ports, airfields, bases, and near-shore sea areas they depend on to conduct military operations. Systems intended to counter U.S. naval forces in littoral areas could include advanced diesel-electric submarines, mines, anti-ship cruise missiles, air-defense systems, and potentially, weapons of mass destruction. Defense analysts²² envision that undersea platforms that can penetrate these areas do not require forward basing agreements and would be of increased value in the future. The Navy's current submarine transformation efforts include a project on ideas for expanding the number and variety of weapons and sensors carried by Navy attack submarines.

Transformation advocates have identified the SSGN as having transformational potential while the refueled SSN-688s would provide no new capabilities and have limited remaining hull life and available volume for upgrades. As a quiet, self-sustaining undersea platform, the SSGN could penetrate the littoral battlespace and counter area denial tactics. The large size and stability of the SSGN would allow for modifications to enable experimentation with future concepts and such potentially transformational capabilities.

Officials noted, however, that a two SSGN class would provide less flexibility than the four-ship class to conduct joint experimentation, transformational concept development and special operations forces operations while at the same time attempting to provide any significant amount of forward presence.

²² *A Strategy for a Long Peace*, Kosiak, Krepinevich, and Vickers, Center for Strategic and Budgetary Assessments, January 2001.



Transformation: Trident SSGN Transformational Features

- Stealth
 - Speed, mobility, and range
 - Large, flexible payloads
 - Operates autonomously with minimal logistics support
 - Long range precision weapons
 - Networked with other naval and joint warfighting elements
 - Potential to conduct unique forms of information warfare
 - Potential to combine short reaction strike and enhanced ISR capabilities
-

Transformation advocates have long identified the SSGN as having transformational potential. In 1996, the Center for Strategic and Budgetary Assessments identified the SSGN as a promising alternative for the Navy's "restructuring efforts."²³ In 1997, the National Defense Panel, created by Congress to review the 1997 QDR and assess force alternatives, recommended that the Navy look closely at converting Trident SSBNs to

²³ *A Navy for a New Era*, Krepinevich, Andrew, Center for Strategic and Budgetary Assessments, May 1996.

alternative missions.²⁴ In 1998, The Defense Science Board Study “Joint Operational Superiority in the 21st Century” also endorsed the SSGN concept. In addition, Congress has had continuing interest in the SSGN concept and has provided funding for studies and initial design work.

The continuing interest in the SSGN concept by transformation advocates stems from the SSGN’s transformational features. First, the SSGN’s stealth would be advantageous to survival in the crowded near shore waters where the Navy expects to operate in the 21st century. The SSGN would be able to operate covertly near enemy coasts undetected for weeks or months, if necessary. Second, its speed, mobility, and range combined with large, flexible payloads would enable it to respond to a variety of developing world events. Third, because submarines do not require extensive logistics support to operate forwardly they would not be dependent on vulnerable forward bases or surface assets. Fourth, the SSGN’s precision-guided Tomahawk missiles would reach distant targets about 1,000 miles away, providing extensive strike capability into areas denied other U.S. forces. Furthermore, it would have the potential to carry follow-on weapons such as unmanned aerial and undersea vehicles, improved communications and other new technologies to counter emerging threats. Fifth, the Navy has made a concept known as network centric warfare the centerpiece of its efforts to transform its forces.²⁵ With its improved communications, large antennas for sharing data and the ability to network with other naval and joint warfighting elements the SSGN would further contribute to the Navy’s vision for network centric warfare. Sixth, the SSGNs combination of stealth, intelligence gathering, and special operations capability would enable it to conduct its own unique forms of information warfare. And finally, war games and experimentation with the SSGN show its potential for using a mix of shortreaction strike weapons and enhanced intelligence collection capabilities to counter the challenge of mobile targets.

²⁴ *Report of the National Defense Panel: Transforming Defense and National Security in the 21st Century*, Odeen, Philip A., et al., December 1997.

²⁵ *Military Transformation: Navy Efforts Should Be More Integrated and Focused* (GAO-01-853, Aug. 2001).

Briefing Section IV: Analysis of Options’ Life-Cycle Costs and Cost-Effectiveness



Net Present Value for the Operational Life Cycle Costs of the Submarine Force Options

(Dollars in billions)	Fiscal year 2001 dollars	Net present value
Refuel four SSN-688s (10-12 years of operational service)	\$2.2	\$1.8
Refuel four SSN-688s and buy four additional <i>Virginia</i> -class replacements (20-22 years of operational service)	7.6	6.6
Convert four Trident SSBNs to SSGNs (20-22 years of operational service)	6.6	4.8
Refuel four SSN-688s and convert two Trident SSBNs to SSGNs (20-22 years of operational service)	5.6	4.2

Source: Our analysis of Navy data.

To compare the operational life-cycle cost of the options, we obtained estimated procurement, operations, maintenance, and personnel costs; determined the funds needed in each fiscal year for each option; converted the costs into fiscal year 2001 dollars; and calculated each option’s net

present value.¹ Because alternative choices are being compared we included the cost of decommissionings that are a consequence of that choice. For example, if the choice is to refuel SSN-688s, DOD would incur the cost of decommissioning four Trident SSBNs (about \$425 million) in addition to the cost of the SSN-688 refueling program. On the other hand, if the choice were to refuel and convert Trident SSBNs, DOD would need to spend about \$200 million to decommission four SSN-688s.

Each of the force structure options provides benefits over different time periods making direct comparisons difficult. Refueling of SSN-688s covers a period of 10 to 12 years of operational service whereas converting Trident SSBNs into SSGNs covers a period of 20 to 22 years of operational service. Because the SSN-688 refueling option does not sustain force level goals of 55 submarines beyond 2016 we considered a third option that buys Virginia-class submarine replacements for decommissioning refueled SSN-688s. Virginia-class submarines have a 6-year construction period preceded by 2 years of advanced procurement of long-lead equipment (mostly propulsion-related equipment), for a total procurement cycle of 8 years for each ship. The net effect of this construction cycle is that the expenditure of procurement funds for replacement submarines begins 2 to 4 years after each SSN-688 is refueled. In order to make the time period for replacement program option comparable to the 20- to 22-year time period for Trident SSGNs, our analysis includes the 10 to 12 years provided by the refueled SSN-688s and the first 10 to 12 years of service life for the Virginia-class submarines. Because the Virginia-class submarines are estimated to have a useful service life of 33 years, we subtract the remaining value of its 21 to 23 years of unused service life from the initial investment cost using a depreciation analysis. We also included the Virginia-class submarine operating and support costs for the first 10 to 12 years.

Since the costs were converted to fiscal 2001 dollars, we used a real discount rate (Treasury borrowing rate minus forecasted inflation) in calculating the net present value.

¹ Because investment alternatives normally incur different costs over different time streams, it is our policy to compare the alternatives on an equal economic basis using a technique called present value analysis. This analysis, by recognizing the time value of money, converts costs occurring at different times to a common unit of measurement, is predicated on the theory that costs incurred in the future are worth less than costs incurred today. Present value analysis also provides a means to transform a stream of costs to a single number so it can be compared to another.



Cost-Effectiveness of Options

Fiscal year 2001 dollars in thousands

	Option 1	Option 2	Option 3	Option 4
	Refuel four SSN-688s	Refuel four SSN-688s and buy four <i>Virginia</i> -class replacements	Convert four SSBNs to SSGNs	Refuel four SSN-688s and convert two SSBNs to SSGNs
Cost per day of presence	\$555	\$1,073	\$234	\$311
Cost per Tomahawk day of presence	46	61	2	3
Cost per SOF platoon day of presence	555	727	37	61

Note: There are no plans to support SOF on the refueled SSN-688s; however, under certain circumstances SOF could be embarked on them for a limited period of time.

Source: Our analysis of Navy data.

Cost-effectiveness analysis seeks to find the least costly alternative for achieving a given program or policy result. We evaluated the cost-effectiveness of the submarine force options in three program areas: (1) submarine presence days, (2) Tomahawk presence days, and (3) special operations forces presence days. Each of these metrics is measurable and are primary missions of the proposed SSGN. Suitable metrics for other missions, such as battle group support and intelligence, surveillance, and reconnaissance, were unavailable. The cost of a presence day was determined by dividing the option’s net present value by the total presence days provided by that option. Each deployed Tomahawk counts as a Tomahawk presence day as does each special operations forces platoon presence day.

Converting four Trident SSBNs to SSGNs is the most cost-effective alternative for providing presence days and in supporting the Tomahawk strike and special operations forces missions. The two key factors affecting the cost-effectiveness measures are the SSGN’s (1) extended deployment periods and (2) massive payload capacities. The SSGN achieves its presence days superior “return on investment” by employing two crews and rotating these crews while the ship is forwardly deployed. An SSGN is estimated to be able to spend 66 percent of its time forward deployed per year compared to 20 percent for a refueled SSN-688.

Notwithstanding the SSGN’s superior cost-effectiveness in the three mission areas we evaluated, the refueled SSN-688s would provide valuable mission support in the areas of intelligence, surveillance, and reconnaissance, undersea warfare, and carrier battle group support.

Briefing Section V: Summary



Summary

Options' Effects on Force Structure

- Refueling four SSN-688s enables the Navy to maintain at least 55 submarines in all but two years from 2002-2016, but makes no contribution after 2016.
- Refueling four SSN-688s and replacing them with four new attack submarines once their service life expires would provide a force level of at least 55 submarines for 32 of 34 years during fiscal years 2002-2035.
- Refueling and converting four Trident SSBNs to SSGNs would provide a force of 55 submarines for 28 of 34 years.
- The option to refuel four SSN-688s and convert two Trident SSBNs to SSGNs would provide a force of 55 submarines for 27 of 34 years.



Summary (con't)

Comparison of Mission Capabilities and Transformational Potential

- Refueled SSN-688s provide superior undersea warfare, surface warfare, battle group support, and better intelligence, surveillance and reconnaissance capabilities but marginal strike and SOF capabilities
- SSGNs provide superior strike, SOF, and forward presence but less capability in other mission areas
- SSGNs significantly augment Tomahawk availability when weapons are most needed
- Converting four Trident SSBNs to SSGNs provides more presence days than any other option and its contribution relative to the baseline is 50 percent greater than the next best option
- SSGNs provide opportunities for experimentation and evaluating new payloads



Summary (con't)

Life Cycle Cost

- Refueling four SSN-688s is less costly than converting four Trident SSBNs to SSGNs
- Converting four Trident SSBNs to SSGNs is less costly than refueling four SSN-688s and buying *Virginia*-class replacements once the SSN-688s' service life expires
- Refueling four SSN-688s and converting two Trident SSBNs to SSGNs cost about the same as converting four Trident SSBNs to SSGNs

Cost-Effectiveness

- SSGNs are more cost-effective than SSNs in providing presence days and forward-deployed strike and SOF
-

Appendix I: Comments From the Department of Defense

Note: Draft report was submitted as GAO-01-115. GAO comments supplementing those in the report text appear at the end of this appendix.



THE ASSISTANT SECRETARY OF THE NAVY
(Research, Development and Acquisition)
WASHINGTON, D.C. 20350-1000

NOV 03 2001

Carol R. Schuster
Director, Defense Capabilities and Management
U.S. General Accounting Office
Washington, D.C. 20548

Dear Ms. Schuster:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report GAO-01-1115, "FORCE STRUCTURE: Options for Enhancing the Navy's Attack Submarine Force," dated September 28, 2001 (GAO code 350033). The DoD generally concurs with the draft report.

The DoD appreciates the opportunity to comment on the draft report. DoD general comments on the draft report are provided below:

The characterization of the conclusions of the 1999 Chairman of the Joint Chiefs of Staff (CJCS) Attack Submarine Force Level Study requires clarification. The CJCS study also concluded that 68 attack submarines (SSNs) in the 2015 time frame and 76 in the 2025 time frame would be required to meet all of the CINCs' and national intelligence community's highest operational and collection requirements. As stated in the September 30, 2001 Quadrennial Defense Review, the current force structure of 55 attack submarines is a baseline from which the Department will develop a transformational force for the future.

Compared with an SSGN, a refueled SSN 688 Class or VIRGINIA Class submarine will in general, be better equipped to meet intelligence surveillance and reconnaissance, undersea warfare and anti-surface warfare missions. An SSGN will be better equipped to support battle group strike or special operations force tasking. However any of the SSN 688 Class, VIRGINIA Class or SSGN submarines will have requisite capabilities to fulfill all of the attack submarine warfare mission areas including assignment to a battle group. Based on availability and other commitments, SSGNs could be multi-tasked to some reduced level in any or all of the attack submarine mission areas.

The GAO cost comparison did not account for platform replacement costs in all four options or across the same number of years. Additionally, in order to fully assess SSN 688 and SSGNs across

See comment 1.

See comment 2.

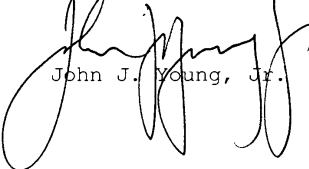
See comment 3.

See comment 4.

a broad set of missions, appropriate metrics would need to be developed for all mission areas.

The current plan to convert torpedo tube launched Tomahawk missiles to vertical launched assets for SSGN is consistent with the long-term plan of changing the Tomahawk inventory to Tactical Tomahawk. Tactical Tomahawks will only be vertically launched. This employment of the current torpedo tube launched Tomahawk assets for SSGN combined with the high forward presence of the platform will bring a much greater average presence of Tomahawk missiles to theater in both peacetime and pre D-day. Despite the current Tomahawk inventories in the Navy, SSGN will provide a higher average number of missiles maintained forward deployed. Filling tubes that are currently empty in notional battle groups could provide roughly 110 additional Tomahawks while the sustained presence offered by a force of four SSGNs would provide 154 additional Tomahawks.

Sincerely,



John J. Young, Jr.

The following is our response to the Department of Defense's (DOD) letter dated September 18, 2001.

GAO Comments

1. DOD's comments restates the requirements discussed on page 9.
2. DOD's comment restates our finding in the Results in Brief, on page 3.
3. See our response in the Agency Comments section of the letter on page 5.
4. We agree with Defense's comment that the SSGN would substantially enhance in-theater Tomahawk presence. Our comparison—which is based on the notional Tomahawk loads the Navy uses in its ordnance requirements determination process and not on budget constrained peacetime actual loads—shows that an SSGN's presence in a theater substantially enhances the Tomahawk presence.

Appendix II: Organizations and Offices Contacted

Washington, D.C., Area

Department of Defense

Office of the Director, Program Analysis and Evaluation

Office of the Under Secretary of Defense for Acquisition,
Technology and Logistics

Defense Intelligence Agency

The Joint Staff

Force Structure, Resources and Assessment Directorate

Chief of Naval Operations

Submarine Warfare Division

Surface Warfare Division

Resources, Requirements & Assessments Division

Office of the Assistant Secretary of the Navy, Research,
Development and Acquisition

Naval Sea Systems Command

Nuclear Propulsion Directorate

Program Executive Officer, Submarines

Virginia-class Program Management Office

Trident Conversion (SSGN) Project Team

Strategic Systems Programs

Office of Naval Intelligence

Other Organizations

Center for Strategic and Budgetary Assessments

Congressional Budget Office

Norfolk, Virginia, Area	U.S. Joint Forces Command
	U.S. Atlantic Fleet
	Submarine Force, Atlantic Fleet
	Naval Special Warfare SEAL Delivery Vehicle Team TWO

Tampa, Florida, Area	U.S. Central Command
	U.S. Naval Forces Central Command
	U.S. Fifth Fleet (Bahrain via video conference)
	U.S. Special Operations Command

Kings Bay, Georgia, Area	Naval Submarine Base Kings Bay
	Submarine Group 10
	Submarine Squadron 16
	Trident Refit Facility
	Trident Training Facility
	U.S.S. Rhode Island (SSBN-740) (Blue)

Newport, Rhode Island, Area	Naval War College
	Naval Undersea Warfare Center

San Diego, California, Area	Naval Special Warfare Command
-----------------------------	-------------------------------

Honolulu, Hawaii, Area	U.S. Pacific Command
	Cruise Missile Support Activity

U.S. Pacific Fleet

Special Operations Command, Pacific Fleet

Submarine Force, Pacific Fleet

U.S.S. Kamehameha (SSN-642)

U.S.S. Buffalo (SSN-715)

Naval Special Warfare SEAL Delivery Vehicle Team ONE

Advanced SEAL Delivery System

Other Contacts

U.S. European Command

U.S. Naval Forces Europe

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